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OPERATOR INSTRUCTION MANUAL FOR VIBRATION ANALYZER/DYNAMIC BALANCER MODEL 355/355M

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OPERATOR
INSTRUCTION MANUAL
FOR VIBRATION
ANALYZER/DYNAMIC BALANCER
MODEL 365/365M

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I INTRODUCTION

The IRD Mechanalysis, Model 355 Vibration Analyzer/Dynamic Balancer is a lightweight portable instrument designed for measurement and analysis of complex machinery vibration, unbalance, and SPIKE ENERGY. The analyzer can be powered from the 115 or 230 volts AC power line, or from the rechargeable batteries provided inside this instrument. A variety of pickups and other input signal sources can be connected to the analyzer. These include velocity pickups, Models 544 and 560 (a special low frequency transducer), the Model 970 Accelerometer, non-contact pickup/signal sensors, vibration monitor outputs, and the sound (noise) output signal of a Model 308 Vibration/Sound Level Meter.

Storage for the standard accessories of the Model 355 is provided inside the removable top cover of this instrument.

The Model 355 can be used for narrow-band analysis of machine vibrations, in-place dynamic balancing, detection of ultrasonic SPIKE ENERGY of rolling element bearing and gear defects, and measurement and analysis of sound (noise) inputs obtained from a Model 308 Vibration/Sound Level Meter.

The use of a Model 560 velocity pickup enables the analyzer to measure, analyze and balance very low RPM machines such as hydroelectric turbines, ship propellers, steel and paper mill rolls, cooling tower fans, helicopter rotors, and many others.

The special SPIKE ENERGY circuits along with the Model 970 Accelerometer are used to detect energy bursts caused by microscopic defects in the bearings and gears of rolling elements. This capability provides the operator with advanced warning of deterioration in these machine components.

When an optional XY Plotter (Model 1080, 1081,or 1082) is used with the analyzer, spectrum plots of the rotating machine vibration, sound (noise), or SPIKE ENERGY can be obtained from 50 to 500,000 CPM. In addition, if a Model 1082 XY Plotter is used with the analyzer, amplitude vs time plots of the vibration, sound, or spike energy can also be obtained.

The amplitude vs time plots of the machine vibration can be extremely valuable during the startup or coast down of the rotating machine to identify the machine criticals, natural frequencies, resonants, or beats.

The amplitude vs time plots of the machine filter-out SPIKE ENERGY can be used to record the SPIKE ENERGY levels of numerous bearings and gears on the same plot. These are very useful in preventive maintenance or troubleshooting the machine.

The measurements and plots obtained from the Model 355 can be readily utilized to pinpoint mechanical defects in rotating machines to specific parts of the machine. Defects such unbalance, bent shafts, looseness and defective bearings and gears can be

found in minimum time, and will reduce unscheduled downtime, production loss, and excessive maintenance. The Model 355 is an ideal instrument for plant-wide preventive maintenance, and is equally well suited for startup of new and refurbished machinery, field service, machinery troubleshooting, quality control and a variety of other applications.

II DESCRIPTION

2.1 DESCRIPTION OF CONTROLS AND INDICATORS

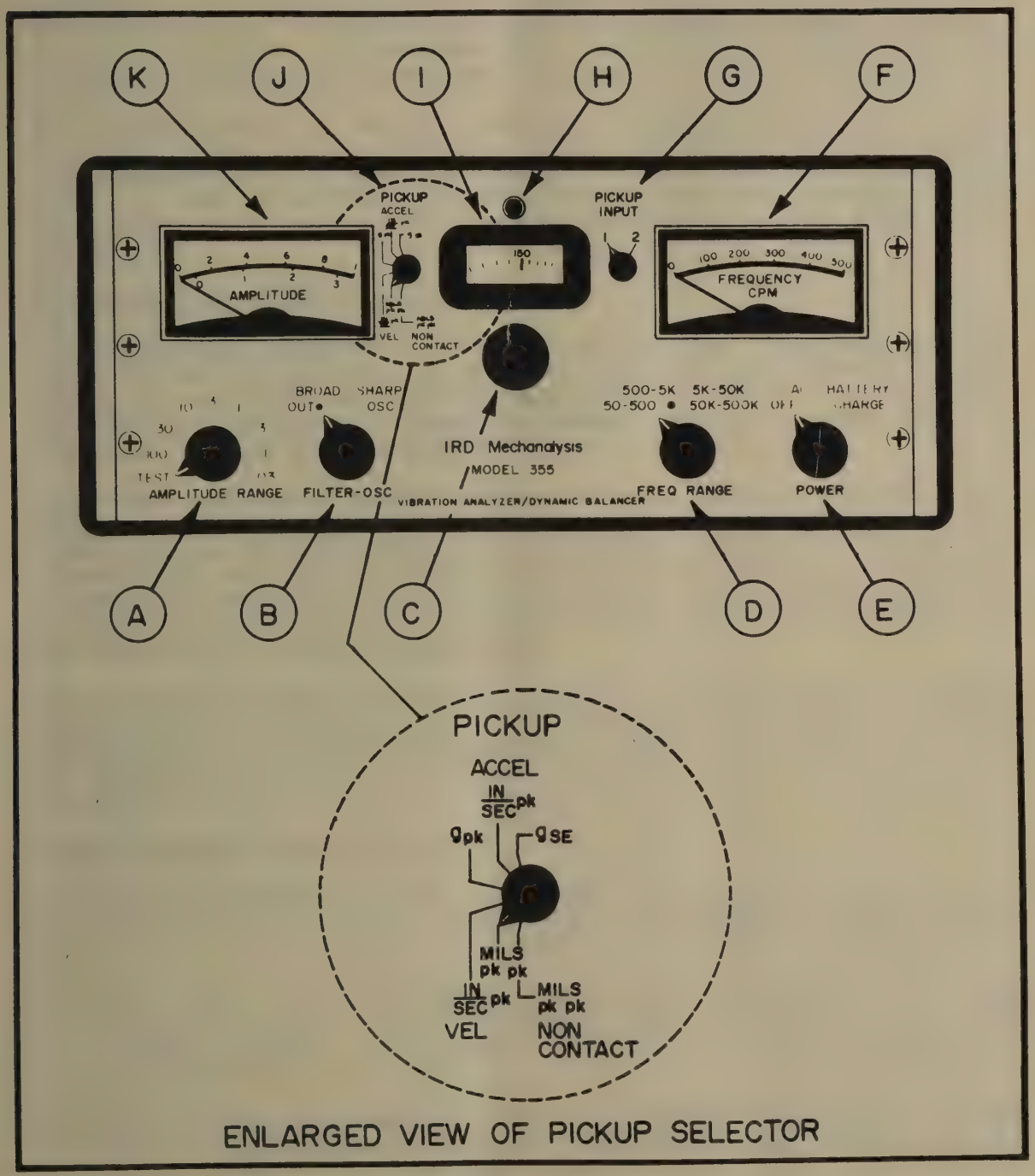

Figure 2-1 Front Panel Controls and Indicators

Amplitude Selector Fig. 2-1 (A)

The AMPLITUDE SELECTOR is used to select the full-scale amplitude range, or the TEST mode. Eight full-scale, overlapped ranges are provided. In English units, the ranges are provided from 0.03 to 100 mils, pk-pk, inches/second, peak, g's, peak, or gSE. In metric units, the ranges are provided from 1.0 to 3000 micrometers, peak to peak, or mm/second, peak; and 0.03 to 100 g's, peak or gSE.

The TEST position is used to test the operation of the instrument circuits. When this position is used, the FILTER-OSC, FREQ RANGE, and PICKUP selectors are each set to the position having a "green dot". If the AMPLITUDE and FREQUENCY meters then indicate within the green "test area", the instrument circuits are functioning correctly.

Filter-Osc Selector, Fig. 2-1, (B)

The FILTER-OSC SELECTOR is used to select the frequency response range of the instrument. In the OUT position, the vibration input signal is not filtered, and the amplitude of the overall vibration within the instrument frequency range (50 to 500,000 CPM) is indicated on the AMPLITUDE METER.

The BROAD and SHARP positions are used to observe the individual frequency components of the vibration signal, and to exclude all other frequency components. In the BROAD positions, the filter bandwidth is ten percent (10%) of the tuned frequency, and provides a decreased selectivity for easy tuning. In the SHARP position, the filter bandwidth is five percent (5%) of the tuned frequency, and provides a greater selectivity.

The OSC (oscillator) position is used to flash the strobe light at the frequency to which the FREQ. RANGE SELECTOR and the FILTER TUNING DIAL of the Model 355 are set. The strobe light will freeze the rotating part when the flash rates is equal to the rotating speed of this part.

Pickup Selector, Fig. 2-1 (J)

The PICKUP SELECTOR is used to select the desired measuring units and the correct input circuitry for the pickup/transducer being used. The measuring units and pickups to be used are as follows:

a.) In the ACCEL (accelerometer) positions, are g, peak (acceleration), IN/SEC (mm/sec), peak (velocity), and gSE (spike energy). In these positions, only the Model 970 Accelerometer is used.

b.) In the VEL (velocity) positions, only the Model 544 or Model 560 Velocity pickups are used. The measuring units that can be selected in the VEL positions are MILS (μm), peak-to-peak (displacement), and IN/SEC (mm/sec), peak (velocity).

c.) In the NON-CONTACT position, only a non-contact pickup system is used, and the measuring units are MILS (μm), peak-to-peak (displacement).

Pickup Input Selector, Fig. 2-1 (G)

The PICKUP INPUT SELECTOR is used to connect either of two signal input channels to the analyzer. The No. 1 position connects the input of the VIBRATION PICKUP #1 receptacle, and the No. 2 position connects the input of the VIBRATION PICKUP #2 receptacle.

Amplitude Meter, Fig. 2-1 (K)

The AMPLITUDE METER indicates the amplitude of the vibration or spike energy input signals in the selected measuring units displacement peak-to-peak, velocity peak, acceleration peak, or spike energy). Two scales are provided on the meter, 0 to 1 and 0 to 3. The scale to be used to read the vibration or spike energy amplitude is determined by the position of the AMPLITUDE RANGE SELECTOR.

The green TEST area on the meter scale is used in conjunction with TEST position of the AMPLITUDE RANGE SELECTOR to check the instrument for proper operation.

The dB scale is used to indicate the sound/noise level when a Model 308 Vibration/Sound Level Meter is used to provide the input signal to the Model 355. (Instructions on sound measurements are given in the Model 308 Instruction Manual.)

Frequency Meter, Fig. 2-1 (F)

The FREQUENCY METER indicates the vibration frequency in cycles per minute (CPM) from 50 to 500,000 CPM in the four selectable ranges provided by the FREQ. RANGE SELECTOR. In the OUT (filter out) mode, the meter indicates the predominant vibration frequency. In the FILTER IN mode, the meter indicates the filtered vibration frequency, and in the OSC (oscillator) mode, the meter indicates the tuned frequency of the Model 355 internal oscillator.

The green TEST area on the meter scale is used in conjunction with the TEST position of the AMPLITUDE RANGE SELECTOR to check the instrument for proper operation.

Frequency Range Selector, Fig. 2-1 (D)

The FREQUENCY RANGE SELECTOR is used to select the tunable frequency range of the internal filter, or oscillator. Four tunable ranges are provided, 50 to 500 CPM, 500 to 5,000 CPM, 5,000 to 50,000 CPM, and 50,000 to 500,000 CPM. Increased damping of the FREQUENCY METER is provided automatically when the 50 to 500 CPM range is selected to provide a steady meter indication at the lower frequencies. This function is independent of the FILTER-OSC SELECTOR settings.

The green dot following the screening of the 500-5K position is used to indicate that this position is to be selected when the TEST mode is used.

Filter Tuning Dial, Fig. 2-1 (I)

The FILTER TUNING DIAL indicates the tuned frequency of the analyzer filter, or the internal oscillator. The numerical value of the dial positioned at the hairline indicator equals the tuned frequency. The dial graduations are calibrated in CPM (cycles per minute), and correspond with the FREQUENCY METER scale readings when the 50 to 500 CPM setting of the FREQ. RANGE SELECTOR is used.

For the three higher range settings, the dial readings should be multiplied as follows:

FREQ. RANGE SELECTOR SETTING	FILTER TUNING DIAL MULTIPLIER
500 to 5K	10
5K to 500K	100
50K to 500K	1000

(K equals 1000 in above table.)

NOTE: All tuned frequency values should be read from the FREQUENCY METER.

Filter Tuning Control, Fig. 2-1 (C)

The FILTER TUNING CONTROL is used to tune the analyzer filter, and to rotate the tuning dial. Vernier control of the dial rotation and the filter tuning is provided each time the direction of the rotation is reversed. To fine tune the filter, the rotational direction should be reversed, to obtain a turning ratio of 36:1 during the first rotation of the tuning control. Coarse tuning/rotation is then provided, for a turning ratio of 6:1, until the rotating direction is again reversed.

Power Light, Fig. 2-1 (H)

The POWER LIGHT is lit as long as voltage is connected to the instrument circuits. The light comes on when the POWER SELECTOR is set to any position except OFF.

Power Selector, Fig. 2-1 (E)

The POWER SELECTOR is used to connect the input AC voltage to the instrument, to connect the internal battery voltage to the instrument circuits, or to disconnect all voltages from the instrument circuits.

If set to the AC position (when the AC POWER cable is installed), the instrument is turned on when connected to an external 117-volt, 50, 60 or 400 Hz power source. Internal wiring changes permit 234-volt operation. When connected to the AC power and turned on, the internal batteries receive a trickle charge.

If the POWER SELECTOR is set to the BATTERY position, the internal battery voltages are connected to the instrument circuits. If the POWER SELECTOR is set to the CHARGE position, and the AC POWER cable is installed, the full charging currents are applied to the internal batteries. The batteries can be completely recharged in approximately sixteen hours.

NOTE: Instructions for recharging the analyzer batteries are given in Section 3.5 (Page 3-8).

2.2 DESCRIPTION OF CABLE RECEPTACLES, AC POWER FUSE, AND PURGE LINE CONNECTOR

The location of the Cable Receptacles, AC power fuse and Purge Line Connector are shown in Figure 2-2.

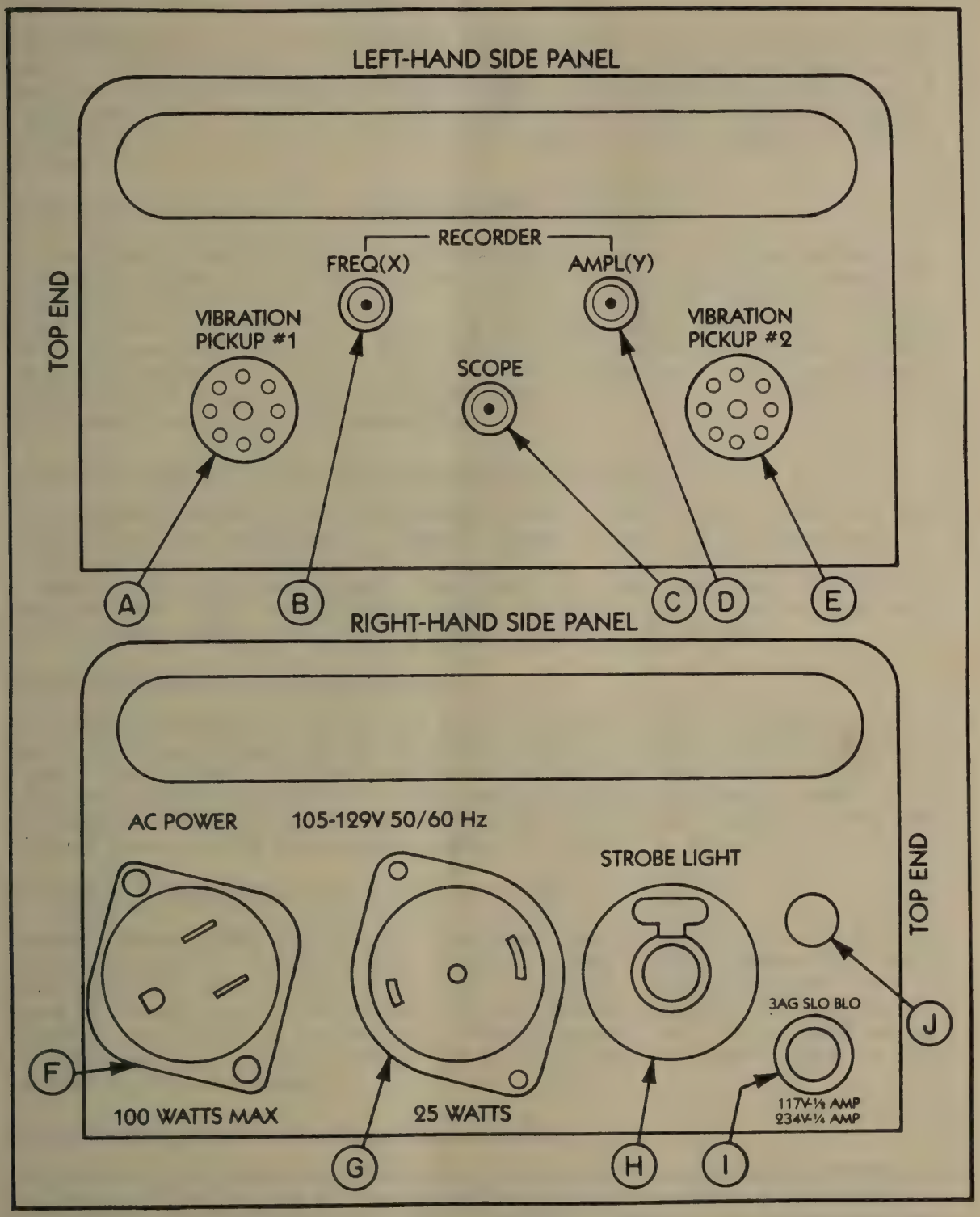

Figure 2-2 Model 355 Side Panels

Vibration Pickup Receptacles, Fig. 2-2 (A)

Two VIBRATION PICKUP RECEPTACLES are provided on the left-hand side panel. Each receptacle consists of a female twist-lock connector for installing the Channel 1 and Channel 2 vibration pickup signal input cables. The No. 1 receptacles receives the Channel 1 cable connector and the No. 2 receptacle receives the Channel 2 input cable.

Recorder Amplitude (Y) Receptacle, Fig. 2-2 (D)

The RECORDER AMPLITUDE (Y) RECEPTACLE is a BNC type connector for installing the amplitude signal input cable of an optional XY Plotter (Model 1080, 1081, or 1082). A DC output voltage proportional to the indication of the AMPLITUDE METER is provided at this receptacle. For a full scale meter deflection, the voltage is approximately 3 volts. This output can be used with strip chart recorders of 1 megohm input impedance, or greater, as well as the previously mentioned XY recorders.

Recorder Frequency (X) Receptacle, Fig. 2-2 (B)

The RECORDER FREQ. (X) RECEPTACLE is a BNC type connector for installing the frequency signal input cable of an optional XY Plotter (Model 1080, 1081, or 1082). A DC output voltage proportional to the tuned frequency of the analyzer filter is provided at this receptacle. With a filter dial setting of 500, the output voltage value is approximately 3 volts DC.

Scope Receptacle, Fig. 2-4, (C)

The SCOPE RECEPTACLE is a BNC type of connector for connection of the vibration signal to an optional oscilloscope or tape recorder. With a full-scale indication provided on the AMPLITUDE meter, the output voltage provided at this receptacle is 1.5 volts RMS, ±0.3 volt (1.0 RMS ±0.2 volt in "SE" mode with 10KHZ input). The BNC signal line is the center pin, and the shell is ground.

AC Power Input Receptacle, Fig. 2-2 (G)

The AC POWER INPUT RECEPTACLE receives the 3-pin twist-lock female connector of the AC Power cable. The 3-pin polarized male connector at the external end of the power cable connects to a 3 wire AC power line disconnect. The standard Model 355 instruments connect to a 105 to 129 volts, single phase, 50, 60 or 400 Hz AC voltage supply (special units can be obtained for connection to 210 to 258 volts on request).

AC Auxiliary Power Outlet, Fig. 2-2 (F)

The AC AUXILIARY POWER OUTLET is a 3-pin polarized female connector for connection of the AC supply voltage to an accessory instrument. The internal conductors of this connector connect to corresponding conductors of the AC Power Input Receptacle. The power output capacity at the AC Power Outlet is 100 watts, maximum.

Strobe Light Connector, Fig. 2-2 (H)

The STROBE LIGHT CONNECTOR receives the spring-lock connector of the output cable to the external Model 569 Strobe Light. To disconnect the strobe light cable from this connector, press down on the PUSH tab, and pull out on the connector.

AC Power Line Fuse, Fig. 2-2 (I)

The AC POWER LINE FUSE is installed inside the fuse holder on the righ-hand side panel. This fuse protects the analyzer circuits from the AC Power Line voltage. A 1/2-ampere, 3AG Slo-Blo fuse, Part No. 1511, is used for 117 VAC operation, and a 1/4-ampere 3AG Slo-Blo fuse, Part No. 5276, is used for 234 VAC operation.

CAUTION: Do not use a higher amperage fuse than listed, as this could cause serious damage to the analyzer.

Purge Line Connector, Fig. 2-2 (J)

The PURGE LINE CONNECTOR is a 1/8-27 NPT threaded hole for connection of a purging line to the instrument case. A threaded plug is installed in the connector to seal the access when not used, and can be removed with an Allen wrench. Instructions for purging the instrument case are provided in Chapter 3.

2.3 DESCRIPTION OF INSTRUMENT CASE

The INSTRUMENT CASE, as shown in Figure 2-3, consists of a two-section carrying case fabricated from lightweight aluminum with an attractive coating of strong vinyl material. Heavy rubber bumpers encircle the case to protect the instrument and accessories from damage. The instrument case is not waterproof and can be contaminated by undue exposure to a hazardous atmospheric or environmental condition. Instructions for purging the case to prevent such contamination are provided in Chapter 3.

The top section of the case is removable, and provides storage for the standard accessories. The instrument is housed in the lower section of the case. Both the top and lower section of the case are gasketed to provide a tight dust seal when storing the instrument.

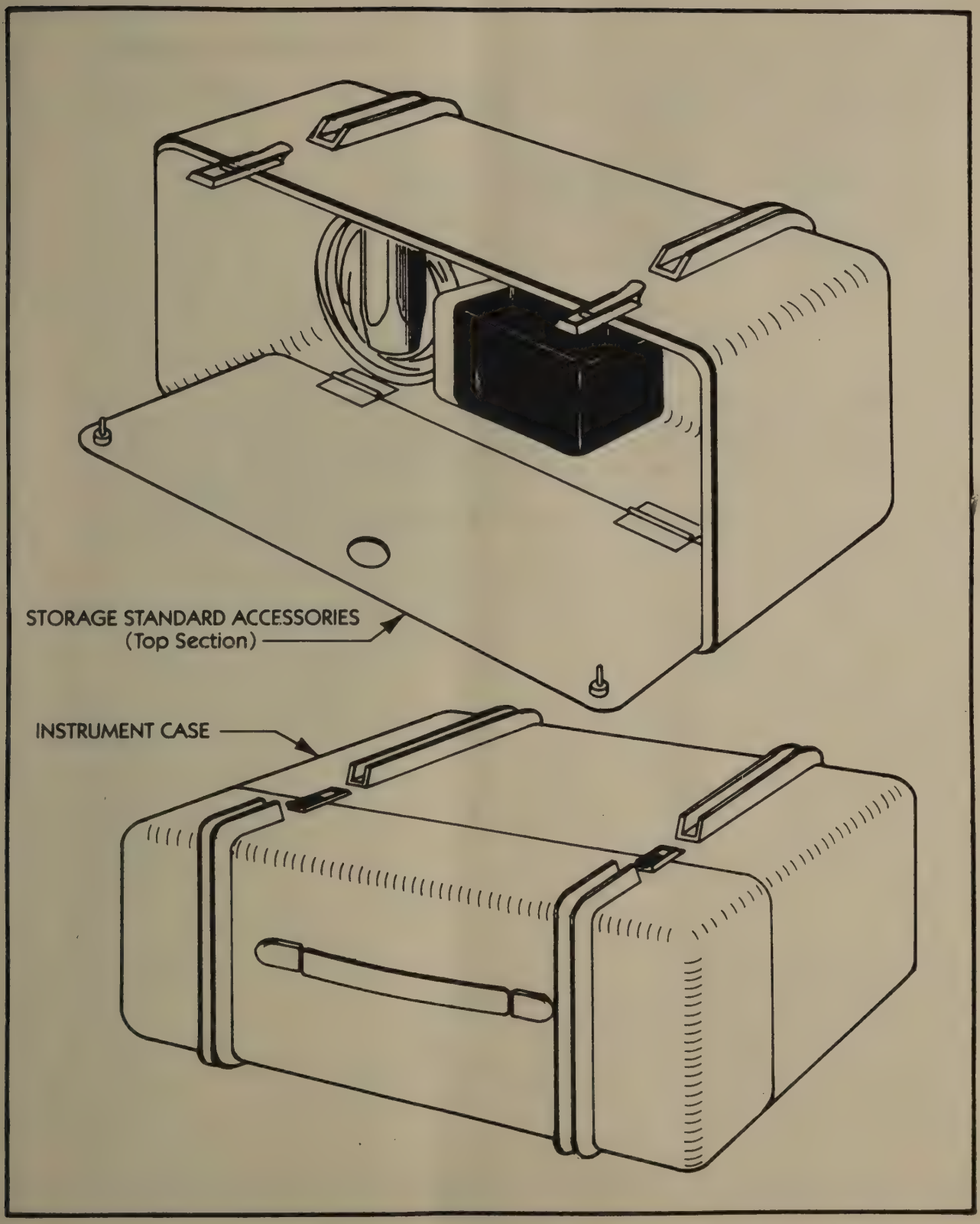

Figure 2-3 Instrument Case

2.4 ACCESSORIES

Standard Accessories

The STANDARD ACCESSORIES supplied with the Model 355/355M instrument are listed below and are illustrated in Figure 2-4.

A. Velocity Transducer, Model 544, Part No. 4526.
B. Pickup Cable for Model 544, 12-foot, Part No. 20433.
C. Accelerometer, Model 970, Part No. 19697.
D. Pickup Cable for Model 970, 12-foot, Part No. 20431.
E. Extension Probe (9-inch) for connection to Model 544, 970, or optional Model 560 Velocity Pickup, Part No. 01103.
F. Strobe Light, Model 569, Part No. 08650.
G. Strobe Light Cable, 12-foot, Part No. 08653.
H. AC Power Cable, 8-foot, Part No. 02501 (with adapter, Part No. 01222).
I. Instruction Manual, Operation, Model 355, Part No. 25057.
J. Data Sheet Pad, Signature Plot, Part No. 10601.
K. Data Sheet Pad, Triaxial Plot, Part No. 12639.
L. Data Sheet Pad, Amplitude/Phase vs RPM/Time Plot, Part No. 21389.
M. Monitor Pickup Cable, Non-Contact, 12-foot, Part No. 24809.

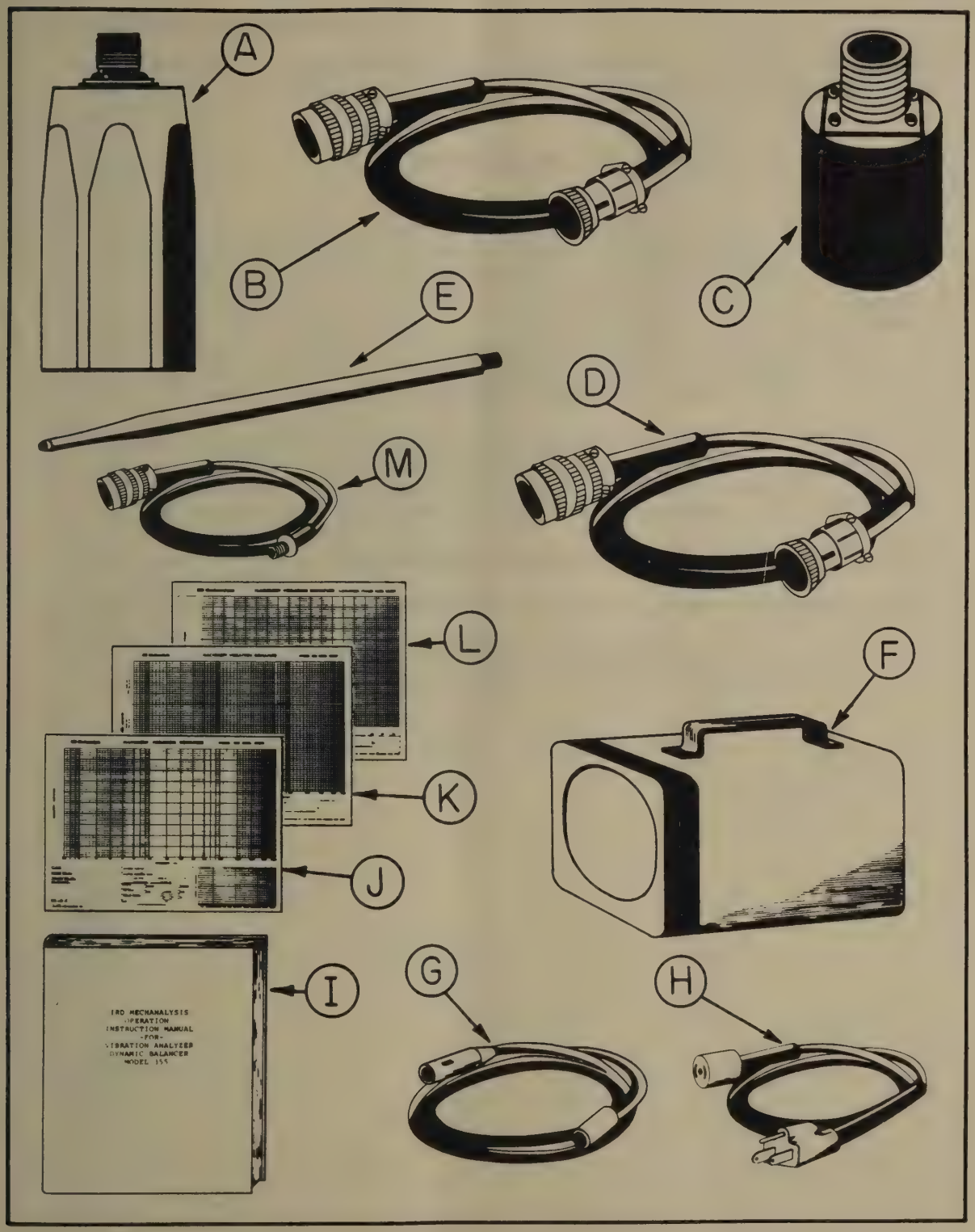

Figure 2-4 Standard Accessories

Optional Accessories

The OPTIONAL ACCESSORIES which are also available for use with the Model 355/355M instrument are illustrated in Figure 2-5A and 2-5B

The following Optional Accessories are illustrated in Figure 2-5A:

A. Extension Cable for Model 970, 25-foot, Part No. 21044.
B. Extension Cable for Model 970, 50-foot, Part No. 21048.
C. Magnetic Holder for Model 970, Part No. 24746.
D. Extension Cable for Model 544, 25-foot, Part No. 21045.
E. Extension Cable for Model 544, 50-foot, Part No. 21049.
F. Magnetic Holder for Model 544/560, Part No. 04332.
G. Magnetic Shield for Model 544, Part No. 10449.
H. Velocity Transducer, Low Frequency, Model 560, Part No. 24957.
I. Pickup Cable for Model 560, 12-foot, Part No. 25136.
J. Extension Cable for Model 560, 25-foot, Part No. 25137.
K. Extension Cable for Model 560, 50-foot, Part No. 25138.
L. Pickup Cable for Non-Contact/Signal Sensor, Part No. 22874.
M. Non-Contact Displacement Accessory, Single Channel, Part No. 09251.
N. Non-Contact Displascement Accessory, Dual Channel, Part No. 09252.
O. Vibration/Sound Level Meter, Model 308.
P. Extension Cable for Strobe Light, 12-foot, Part No. 08653.
Q. Calibrator, Part No. 21073.
R. Strobe Light Bulb, Spare, Part No. 08461.

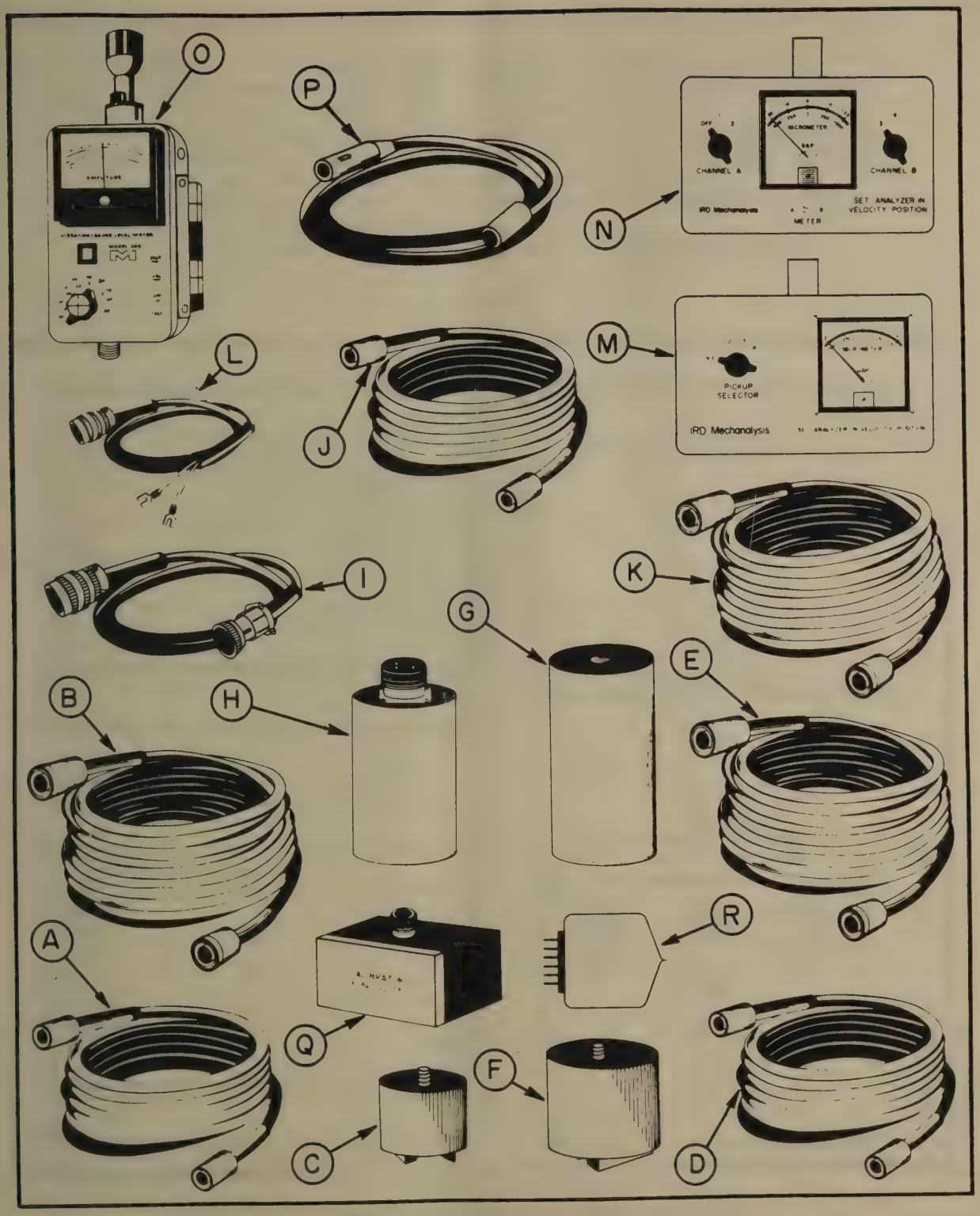

Figure 2-5A Optional Accessories

The following Optional Accessories are illustrated in Figure 2-5B:

A. XY Plotter, Model 1080, Part No. 18323.
(A.C. Power only. For Amplitude vs Frequency Plots).
B. XY Plotter, Model 1081, Part No. 15842.
(A.C./Battery Power: For Amplitude vs Frequency Plots).
C. XY Plotter, Model 1082, Part No. 21070 without battery pack and Part No. 23200 with battery pack.
(AC/Battery Power. For Amplitude vs Frequency Plots and Amplitude vs Time Plots).
D. Transit Case for Model 355 and Accessories, Part No. 10450.

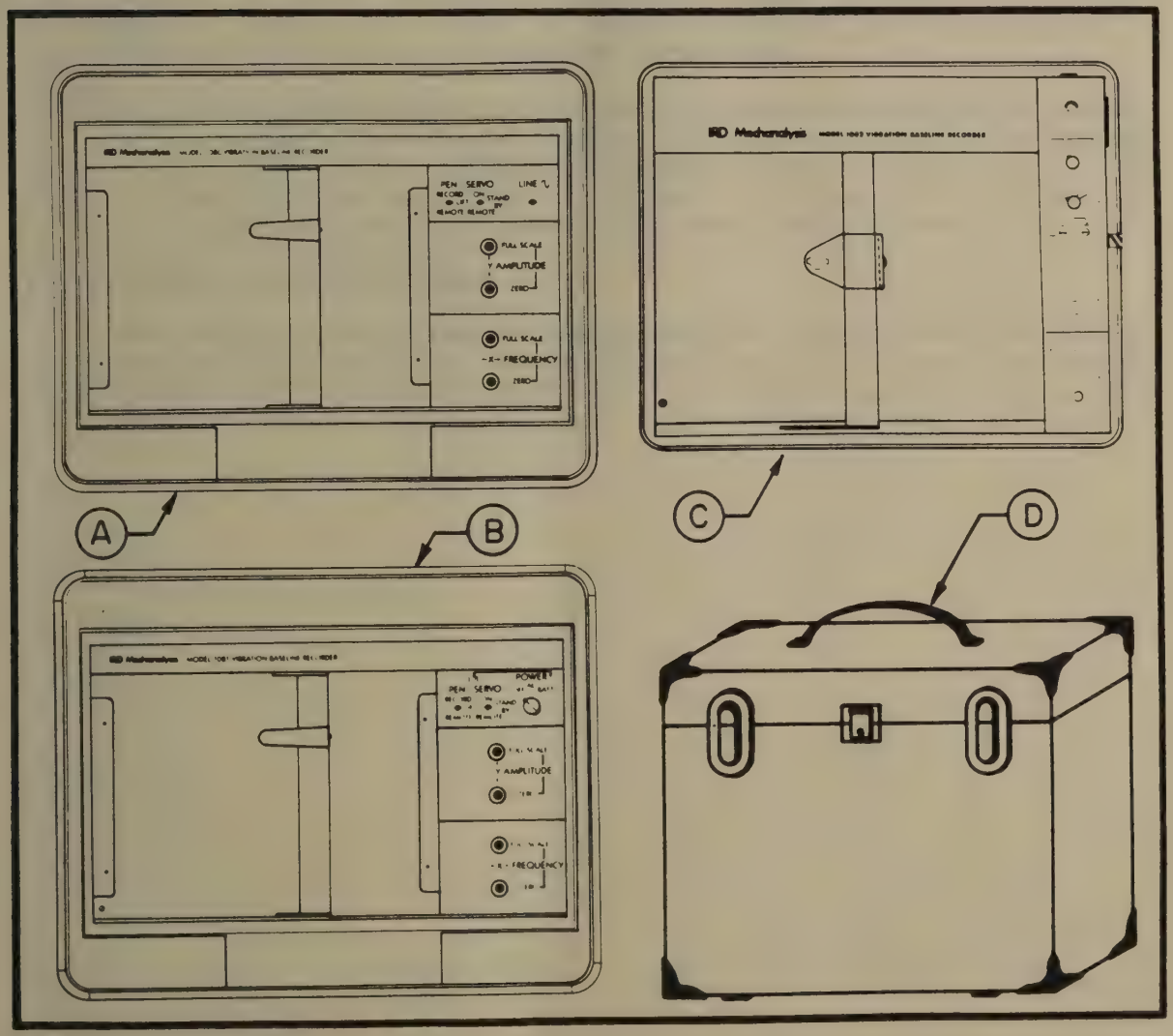

Figure 2-5B Optional Accessories, Continued

III PREPARATION FOR OPERATION

This section describes the procedures for setting up the Model 355 for operation. The procedures described include: cable connectors for operation with various transducers and accessories, circuit checks for A.C. and battery operation, battery recharging and instrument purging.

3.1 AC POWER CABLE CONNECTION

Connect the 3-circuit female twist-lock connector at one end of the AC Power Cable to the AC input receptacle on the right-hand side panel of the instrument. Connect the 3-prong connector at the external end of the Power Cable to the 109-129 volt, single phase, 50/60 Hz fused AC power line (210 to 258 volts, single phase, 50/60 Hz. fused AC power line if the instrument is designed for operation by other voltages).

CAUTION: Before connecting the AC Power to the analyzer, make certain that the AC voltage supply is correct for the instrument, and that the correct AC POWER FUSE is installed. The required AC Power Line voltage and the fuse ratings are listed on the right-hand side panel of the Model 355.

3.2 SIGNAL CABLE CONNECTIONS

The cabling configurations required for the various measurements provided by the Model 355 instrument are illustrated in Figures 3-1 and 3-2. Select the desired configuration and install the required cables as instructed in the sections that follow.

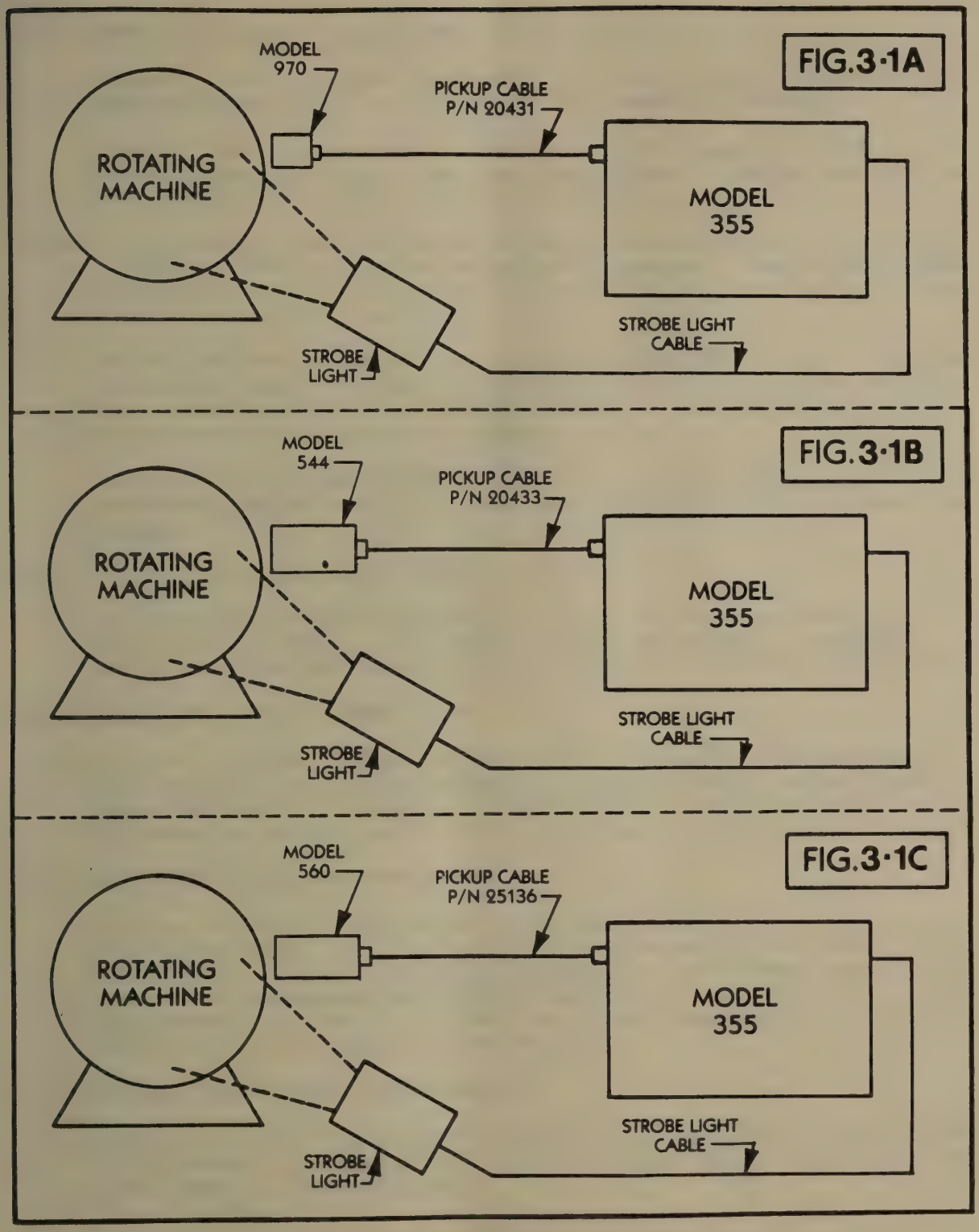

Figure 3-1 Cabling Configurations

3.2.1 MODEL 544 CABLE CONNECTIONS

Connect the threaded connector of the Pickup Cable to the threaded receptacle on the Model 544 Velocity Pickup.

Connect the twist-lock connector at the analyzer end of the Velocity Pickup Cable to the twist-lock receptacles on the left-hand side panel of the analyzer.

NOTE: Two Pickup Connector input channels are available in the Model 355, and either may be selected. However, the PICKUP INPUT SELECTOR must be set to the position corresponding to the selected input channel.

If an extension cable is required, disconnect the threaded connector from the Model 544 connector and connect the threaded male receptacle of the extension cable to the threaded connector at the end of the standard cable.

Connect the threaded female connector at the pickup end of the extension cable to the threaded male receptacle on the Model 544 Pickup.

3.2.2 MODEL 970 CABLE CONNECTIONS

If the Model 970 Accelerometer is to be used rather than the Model 544 Pickup, the same cable connection procedure is followed using the Model 970 Pickup Cable and extension cables.

3.2.3 MODEL 560 CABLE CONNECTIONS

If the optional Model 560 Velocity Pickup (for measurement of low frequency vibration signals) is to be used, rather than the Model 544 or 970 Pickups, the same cable connection procedure is followed using the Model 560 Pickup Cable and extension cables.

3.2.4 CALIBRATOR CABLE CONNECTIONS

If the optional Calibrator, Part No. 21073, is to be used to check the Model 355 calibration for velocity or acceleration measurement, follow the cable connection procedures used for the Model 970 Accelerometer cable connections (Section 3.2.2), with the exception that the Calibrator output connector is connected in place of the Model 970 Connector.

3.2.5 STROBE LIGHT CABLE CONNECTIONS

Insert the male snap-lock connector at one end of the Strobe Light Cable into the STROBE LIGHT receptacle on the right-hand side panel of the analyzer.

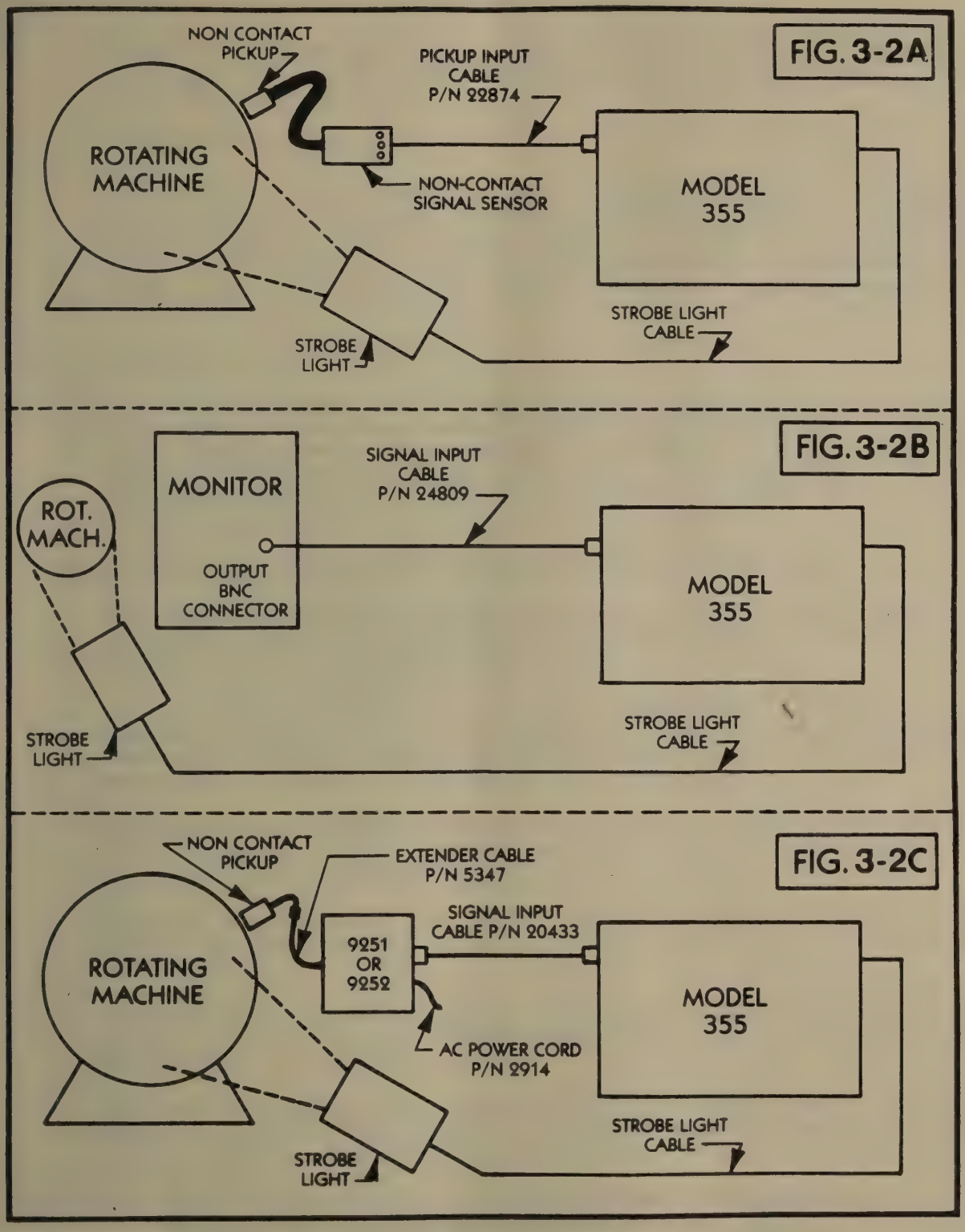

Figure 3-2 Cabling Configurations Continued

3.2.5 STROBE LIGHT CABLE CONNECTIONS (Cont'd.)

Insert the snap-lock connector at the other end of the Strobe Light Cable into the mated receptacle on the rear side of the Model 569 Strobe Light.

3.2.6 XY PLOTTER CABLES

Instructions for connecting the XY Plotter cables to the Model 355 Analyzer are given in the Instruction Manuals for these optional accessories. Manual Part No. 26488 is used with the Model 1080 XY Plotter; Manual Part No. 26487 is used with the Model 1081 XY Plotter; and Manual Part No. 24226 is used with the Model 1082 XY Plotter.

3.2.7 MODEL 308 CABLE CONNECTIONS

The optional Model 308 Vibration/Sound Level Meter can be used when sound is to be measured rather than vibration. In this case, follow the cable connection procedures for the Model 544 Pickup Cable (see Section 3.2.1) with the exception that the Model 308 output connector is connected in place of the Model 544 Connector.

3.2.8 NON-CONTACT DISPLACEMENT ACCESSORY CABLE CONNECTIONS

The cabling diagram showing the cabling connections used with the Non-Contact Displacement Accessory, and the cable Part Numbers is illustrated in Figure 3-2.

Follow the procedures for installing the Model 544 Pickup Cable (Section 3.2.1) with the exception that the signal output connector of the Model 9251, or Model 9252, Accessory is connected in place of the Model 544 connector.

Connect the threaded fitting at the 9251, or 9252, end of the Extender Cable to the threaded male fitting on the top rear side of the 9251 or 9252 Accessory.

Connect the threaded fitting at the pickup end of the Extender Cable to the threaded fitting at the end of the non-contact pickup cable.

Connect the 3-circuit female fitting at one end of the A.C. Power Cable to the A.C. POWER INPUT receptacle on the rear side of the 9251 or 9252 Accessory.

Connect the 3-prong male receptacle at the other end of the A.C. Power Cable to the auxiliary AC Power output connector on the right-hand side panel of the analyzer.

CAUTION: Make certain that the Model 9251 or 9252 Accessory unit is designed and correctly fused for the AC Power Line voltage to be used.

3.2.9 NON-CONTACT PICKUP/SIGNAL SENSOR CABLE CONNECTIONS

The cabling diagram showing the cable connections to be used, and the cable part number is illustrated in Figure 3-2.

Connect the conductor wires having spade lugs at one end of the cable to the SIGNAL and GROUND terminals of the external Signal Sensor.

Connect the twist-lock connector at the analyzer end of the signal input cable to either of the twist-lock signal input receptacles on the left-hand side panel of the analyzer.

NOTE: The Model 355 is calibrated to operate with signal sensors having output sensitivities of 200 mv/mil (7.9 mv/um). Power to operate the signal sensor should be connected from an external source, not from the 355 instrument.

3.2.10 NON-CONTACT MONITOR OUTPUT CABLE CONNECTIONS

The cabling diagram showing the cable connections to be used, and the cable part number is illustrated in Figure 3-2.

Connect the BNC connector at the monitor end of the signal input cable to the BNC SIGNAL OUTPUT connector on the front panel of the monitor.

Connect the twist-lock connector at the analyzer end of the signal input cable to either of the twist-lock signal input receptacles on the left-hand side panel of the analyzer.

NOTE: The Model 355 is calibrated to operated with non-contact monitors having output sensitivities of 200 mv/mil (8.1 mv/um).

3.3 AC POWER CIRCUIT OPERATION CHECK

1. Set the POWER SELECTOR to AC and check that the POWER ON light turns on.

2. Set up the Model 355 controls as follows:

   a) Set the PICKUP SELECTOR to the MILS pk-pk position for the VEL (velocity) pickup. (a "green" dot is also shown at the correct MILS pk-pk position).

   b) Set the AMPLITUDE RANGE SELECTOR to TEST (a "green" dot is also shown at this position).

   c) Set the FILTER-OSC SELECTOR to OUT (a "green" dot is also shown at this position).

   d) Set the FREQUENCY RANGE SELECTOR to the 500-5K position (a "green" dot is also shown at this position).

3.3 AC POWER CIRCUIT OPERATION CHECK (Cont'd.)

e) Check that the AMPLITUDE and FREQUENCY meters each indicate within the green TEST area of the meter scales. If both meters indicate within the TEST area, the Model 355 circuits are functioning correctly.

f) Set the FILTER-OSC selector to "SHARP".

g) Tune the filter tuning dial through a reading of 400 and note that the AMPLITUDE meter reading peaks when the dial reads approximately 400.

With the AMPLITUDE meter reading tuned to a peak, a meter reading within the green test area on both the AMPLITUDE meter and the FREQUENCY meter indicates normal FILTER-SHARP operation.

h) Repeat step g with FILTER-OSC set to "BROAD".

With the AMPLITUDE meter reading tuned to peak, a meter reading within the green test area on both the AMPLITUDE meter and the FREQUENCY meter indicates normal FILTER-BROAD operation.

i) Set the FILTER-OSC selector to "OSC". The Model 569 Stroboscopic Light is operated by its three-position switch. If set to the center (OFF) position, the light is shut off. If set to the rear (ON) position, the strobe light is operated. If set to the forward (ON) spring-return position, the strobe light is operated as long as the switch is held in this position. When the switch is in either ON position, the strobe light should flash at the rate indicated by the filter-tuning dial and the FREQ RANGE selector, up to 15,000 CPM. Above 15,000 CPM, the strobe light flashes at a sub-multiple of the indicated frequency.

3.4 BATTERY POWER CIRCUIT OPERATION CHECK

1. Set the POWER SELECTOR to BATTERY and check that the power on light turns on.

2. Set the Model 355 controls to the same positions listed in Step 2 of Section 3.3 and perform the same circuit tests.

3. Check that the indicators of the AMPLITUDE and FREQUENCY METERS indicate at the center, or higher, of the green TEST area of the meter scales.

CAUTION: If the meters indicate below the center of the TEST area, the batteries are low and should be recharged before the analyzer is operated in the BATTERY mode.

3.4 BATTERY POWER CIRCUIT OPERATION CHECK (Cont'd.)

4. For strobe light operation in the BATTERY mode, it is recommended that the spring return position on the strobe switch be used to conserve battery power.

NOTE: After using the strobe light on battery power, the batteries should be recharged as instructed in Section 3.5.

3.5 RECHARGING BATTERIES

The internal batteries require recharging if the AMPLITUDE and FREQUENCY METERS indicate below the center of the green TEST area on the meter scales when the analyzer operation is in the TEST mode. The Model 355 batteries are high quality Nickel-Cadmium batteries capable of hundreds of charge/discharge cycles in normal instrument operation. To obtain best performance and longest battery life, the batteries should be maintained in a fully charged condition. This is easily done by recharging (1) whenever the instrument has been used in Battery mode, and (2) once/month even if the instrument is not in use (Nickel-Cadmium cells lose their charge over a period of several weeks).

When the analyzer is operated with POWER SELECTOR in "AC" a trickle charge will maintain a full charge; however, the trickle charge is not adequate for recharging if the batteries are known to be discharged.

To recharge the batteries, proceed as follows:

1. Install the AC POWER CABLE as instructed in Section 3.1.

2. Set up the Model 355 selectors as instructed in Step 2 of Section 3.3.

3. Set the POWER SELECTOR to CHARGE.

4. Operate the analyzer in the CHARGE mode for approximately 16 hours to fully recharge the internal batteries.

5. Reset the POWER SELECTOR to the BATTERY position, and recheck the AMPLITUDE and FREQUENCY meter indications.

NOTE: The batteries are fully recharged if the AMPLITUDE and FREQUENCY meters indicate at the high end of the green TEST area. However, the analyzer can be operated by the batteries if the meters indicate at or above the center of the green TEST area.

3.6 PURGING INSTRUMENT CASE

The threaded PURGE LINE connector on the right-hand side panel of the instrument is used for connection of an external purging air/nitrogen supply line. The connector threading is 1/8-27 NPT. A threaded plug is installed to seal the hole when purging is not used. The plug is removable, using a 1/16-inch Allen wrench. The pressurized purging supply should not exceed 50 PSI, and should be applied to the instrument for 15 minutes, or longer, before applying power to the instrument.

CAUTION: Purging of the Model 355 may be required for flushing the instrument, or for pressurizing the interior with clean-dry air or nitrogen to exclude all hazardous/corrosive gases and vapors. If required, make certain that the instrument is purged before power is applied.

MEMORANDA

IV OPERATION

4.1 GENERAL

This chapter contains instructions for operation of the Model 355 instrument with various transducers and accessories: Model 970 Accelerometer, Model 544 Velocity Pickup, optional Model 560 Velocity Pickup (for measuring low frequency vibration), non-contact signal sensor, non-contact and other monitors, Model 308 Vibration/SoundLevel Meter and XY Plotters (Model 1080, 1081, or 1082).

The specific procedures which are covered in this section include:

Filter Out Vibration Measurement/Analysis
Peak Tuning (Filter In) Measurement/Analysis
Strobe Light (Filter In) Measurement/Analysis
Vibration Spectrum Plot Measurement/Analysis
Vibration Time Base Plot Measurement/Analysis
Spike Energy Measurement/Analysis
Sound (Noise) Measurement/Analysis
In-Place Balancing

Specifications of the Model 355 and major accessories are provided in Appendix A. Information on the significance of the measured vibration amplitude levels in displacement, velocity and acceleration is provided by guideline severity charts in Appendix B. In addition, procedures for evaluation of the measured Spike Energy are given in Appendix C.

4.2 VIBRATION MEASUREMENT AND ANALYSIS

Machine vibrations are generally complex and may consist of many frequencies from different sources. Vibration measurement and analysis are the processes of measuring and analyzing the vibration of a machine to determine the amplitude and frequency of each vibration component in the spectrum, and relating these to the know machine characteristics to pinpoint the causes of the various vibrations.

To determine the vibration characteristics of a machine, the overall vibration should be measured and the internal filter of the analyzer tuned to the frequencies of the individual vibration components, much like a radio is tuned to the individual stations.

In the sections which follow, the different procedures for vibration measurement and analysis are discussed.

4.2.1 FILTER OUT MEASUREMENT/ANALYSIS

The procedure for filter out vibration measurement and analysis is as follows:

1. Prepare the Model 355 for operation as instructed in Chapter III (the analyzer can be powered by the AC line voltage or the internal batterie)s.

2. Set the FILTER-OSC SELECTOR to the OUT (filter out) position.

3. Select the desired measuring units for the pickup to be used and set the PICKUP SELECTOR to the corresponding position.

NOTE: Details regarding the preferred measuring units to be used are covered in the IRD Customer Training Programs. See your IRD representative, or contact IRD Mechanalysis, Inc. for further information.

4. Install or hand hold the vibration pickup on the bearing housing (or other measuring point) of the rotating machine.

5. Set the AMPLITUDE RANGE SELECTOR to 100, and then rotate the selector progressively to the more sensitive ranges (turn clockwise) until an AMPLITUDE METER indication of 1/3 the full-scale value (or higher) is obtained. The indicated value is the amplitude of the vibration at the point where the pickup is mounted. The vibration levels are indicated on the AMPLITUDE METER which cntains two scales. (A third "dB" scale is used for sound measurements). The top scale reads from 0 to 1.0, and the bottom scale reads 0 to 3.0. The setting of the AMPLITUDE RANGE SELECTOR determines the meter scale to be used and the full scale value. If the selector is set to 100, 10, 1, or 0.1, the top meter scale is used. The full-scale values for their settings are 100, 10, 1, and 0.1 respectively (in terms of the measuring units used). The bottom meter scale is used when the AMPLITUDE RANGE SELECTOR is set to 30, 3, 0.3, or 0.03. The full-scale values for these settings are 30, 3, 0.3, and 0.03, respectively (also in terms of the measuring units used). To determine the amplitude of the indicated value, select the meter scale to be used, read the indicated value, and then shift the decimal point to the righ or left in accordance with the AMPLITUDE RANGE SELECTOR setting.

6. Flash the strobe light onto various rotating parts of the machine.

NOTE: The rotating part causing the predominant vibration will enable the light to flash in sychronization with its rotating speeds and will appear to stop (freeze) the rotating part.

7. Determine the rotating part that is causing the predominant vibration. (In the OUT mode, the predominant vibration frequency rotating speed may be indicated on the FREQUENCY METER.)

NOTE: The speed indicated on the FREQUENCY METER is affected by the relative amplitude and frequency of all the vibration signal components. The circuits of the meter sense all positive-going zero-crossings. Therefore, in filter-out, the FREQUENCY METER will indicate the predominant vibration frequency if one dominant frequency is present. If there is no dominant vibration, the FREQUENCY METER needle will oscillate erratically. Occasionally, when two reasonably closely spaced vibrations of approximately equal amplitude are present (e.g. 1800 CPM and 2600 CPM), the FREQUENCY METER needle will jump back and forth between these two frequencies.

4.2.2 PEAK TUNING (Filter In) MEASUREMENT/ANALYSIS

Normally, the machine vibrations occur at frequencies of 1, 2, 3, 4, and sometimes higher multiples of the rotating speed of the machine part causing the trouble. Checking the rotating speeds listed on the rotating machine nameplate may reveal the vibration frequencies that are likely to be present. Three methods can be used for tuning the Model 355 filter, and are explained in this section and in Sections 4.2.3 and 4.2.4 which follow.

In the peak tuning procedure, the steps are as follows:

1. Set the FILTER-OSC SELECTOR to the BROAD position.

2. Set the FREQUENCY RANGE SELECTOR to the range that includes the machine rotating speed. (For example, if the machine rotating speed is 1800 RPM, the FREQUENCY RANGE SELECTOR should be set to the 500-5K range.)

3. Adjust the FILTER TUNING DIAL so that the approximate machine RPM speed is positioned under the hairline indicator of the tuning dial window. Then, setup the AMPLITUDE RANGE SELECTOR so that an indication of 1/3 of full-scale, or higher, is obtained on the AMPLITUDE METER.

4. Rotate the FILTER TUNING KNOB so that the filter is tuned just above the peak point of the AMPLITUDE METER. Then, set the FILTER-OSC SELECTOR to SHARP, and rotate the FILTER TUNING KNOB in the opposite direction slowly so that the peak indication is obtained on the AMPLITUDE METER. If the meter amplitude decreases, turn the dial in the opposite direction slowly until the peak AMPLITUDE METER indication is obtained.

5. Note the vibration amplitude indicated on the AMPLITUDE METER, and the vibration frequency indicated on the FREQUENCY METER.

NOTE: Make certain that the FREQUENCY METER indication is read correctly, it must coincide with the FREQUENCY RANGE being used. (For example, if the FREQUENCY METER indication is 50, and the FREQUENCY RANGE SELECTOR is set to the 5K-50K range, the frequency at the indicated point "50" is equal to 5K CPM, or 5000 CPM.)

6. Tune the filter for each vibration component present in the same manner used in Steps 2 through 4. Tune through the entire frequency range to determine the components that are present. Turn the tuning knob slowly to allow time for the instrument meters etc., to react. In addition, reposition the AMPLITUDE RANGE SELECTOR when required, to maintain the up-scale indication on the AMPLITUDE METER.

NOTE: If desired, the BROAD filter mode can be used when scanning through the frequency ranges to detect the vibration components in each range. To obtain maximum filtering, tune to each peak using the BROAD mode, then switch to the SHARP mode while fine tuning to the peak.

7. By placing the vibration pickup at various points on a machine (typically, these points are the horizontal, vertical and axial directions at each bearing housing), a record of the machine can be obtained. Figure 4-1 shows a form which can be used to record the measurement data.

4.2.3 STROBE LIGHT (Filter In) MEASUREMENT/ANALYSIS

1. Set the FILTER-OSC to the OSC (oscillator) position.

2. Set the FREQUENCY RANGE SELECTOR to the range that includes the machine rotating speed. (For example: if the machine rotating speed is 1800 CPM, the FREQUENCY RANGE SELECTOR should be set to the 500 - 5K range.)

3. Adjust the FILTER TUNING DIAL so that the approximate machine rotating speed is positioned under the hairline indicator on the tuning dial window.

4. Flash the strobe light to illuminate the rotating shaft (the reference mark on the shaft - shaft keyway or chalk mark - will appear to rotate slowly under the strobe light).

5. Adjust the Tuning Dial carefully so that the strobe light freezes the shaft (the mark should appear to stay in one position).

6. Set the FILTER-OSC SELECTOR to SHARP, and again fine tune the Tuning Dial so that this is frozen. The analyzer filter is now tuned precisely to the rotating speed of the machine shaft.

7. Record the vibration amplitude and the frequency. (See the sample for for recording this data in Figure 4-1).

IRD MECHANALYSIS, INC. **DATA SHEET** DATE _____

☐ NOISE ☐ VIBRATION ANALYSIS OF: _____

FOR: _____ TEST CONDITIONS:

MECHANALYSIS EQUIPMENT USED:

PERFORMED BY: _____

LEGEND:
→ PICKUP POINT
X PLAIN BEARING
⊠ ANTI-FRICTION BEARING
⊣⊢ COUPLING

PICKUP		FILTER OUT						FILTER IN					
		NOISE		DISPL.		VELOCITY							
POINT	POS.	dB(A)	CPM	MILS	CPM	IN/SEC	CPM						
	H												
	V												
	A												
	H												
	V												
	A												
	H												
	V												
	A												
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	H												
	V												
	A												
	H												
	V												
	A												
	H												
	V												
	A												

Figure 4-1 Typical Vibration History Form

8. Repeat Steps 1 through 7 with the vibration pickup mounted at each of the selected measurement points on the machine. Typically, these measurements will be in the horizontal, vertical and axial directions at each bearing housing. Such measurements will provide a good description of the machine vibrations.

NOTE: At each measurement point, the vibration should be measured in both the OUT (filter out) and SHARP modes.

9. When the vibration measurements have been completed (measured and recorded), determine the seriousness of each vibration from the vibration severity charts provided in Appendix B.

10. Determine the nature of the machine trouble causing any vibrations that are excessively high from the Vibration Identification Chart provided in Figure 4-2.

VIBRATION IDENTIFICATION

CAUSE	AMPLITUDE	FREQUENCY	PHASE	REMARKS
Unbalance	Proportional to unbalance. Largest in radial direction.	1 x RPM	Single reference mark.	Most common cause of vibration.
Misalignment couplings or bearings and bent shaft	Large in axial direction 50% or more of radial vibration	1 x RPM usual 2 & 3 x RPM sometimes	Single double or triple	Best found by appearance of large axial vibration. Use dial indicators or other method for positive diagnosis. If sleeve bearing machine and no coupling misalignment balance the rotor.
Bad bearings anti-friction type	Unsteady - use velocity measurement if possible	Very high several times RPM	Erratic	Bearing responsible most likely the one nearest point of largest high-frequency vibration.
Eccentric journals	Usually not large	1 x RPM	Single mark	If on gears largest vibration in line with gear centers. If on motor or generator vibration disappears when power is turned off. If on pump or blower attempt to balance.
Bad gears or gear noise	Low - use velocity measure if possible	Very high gear teeth times RPM	Erratic	
Mechanical looseness		2 x RPM	Two reference marks. Slightly erratic.	Usually accompanied by unbalance and/or misalignment.
Bad drive belts	Erratic or pulsing	1, 2, 3 & 4 x RPM of belts	One or two depending on frequency. Usually unsteady.	Strob light best tool to freeze faulty belt.
Electrical	Disappears when power is turned off.	1 x RPM or 1 or 2 x synchronous frequency.	Single or rotating double mark.	If vibration amplitude drops off instantly when power is turned off cause is electrical.
Aerodynamic hydraulic forces		1 x RPM or number of blades on fan or impeller x RPM		Rare as a cause of trouble except in cases of resonance.
Reciprocating forces		1, 2 & higher orders x RPM		Inherent in reciprocating machines can only be reduced by design changes or isolation.

IRD # 303

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Figure 4-2 Vibration Identification Chart

4.2.4 SPECTRUM PLOT MEASUREMENT/ANALYSIS

An XY Plotter (Model 1080, 1081, or 1082) can be used with the Model 355 Analyzer to obtain a spectrum plot of the machine vibration. In addition, the Model 1082 XY Plotter can also be used with the analyzer to obtain a time-base plot of the overall (filter out) vibration.

The spectrum or time-base plots are easily obtained, and generally enable the machine analysis to be performed faster and with increased accuracy. The hard copy plots also provide a permanent record of the machine measurements and can be filed for future reference.

Detailed instructions on the setup and operation of the XY Plotter for use with the Model 355 analyzer are given in the Instruction Manuals supplied with these accessories; however, the basic steps for making a plot are as follows:

1. Set up the analyzer for operation with an XY Plotter as instructed in Chapter III.

2. Select the proper transducer for the specific measurement to be carried out.

3. Attach the transducer to the rotating machine.

4. Set the Model 355 PICKUP SELECTOR to the position for the measuring units selected and the vibration transducer being used.

5. Generate the XY spectrum plot either manually or automatically as instructed in the XY Plotter operation manual. A typical vibration spectrum plot is shown in Figure 4-3.

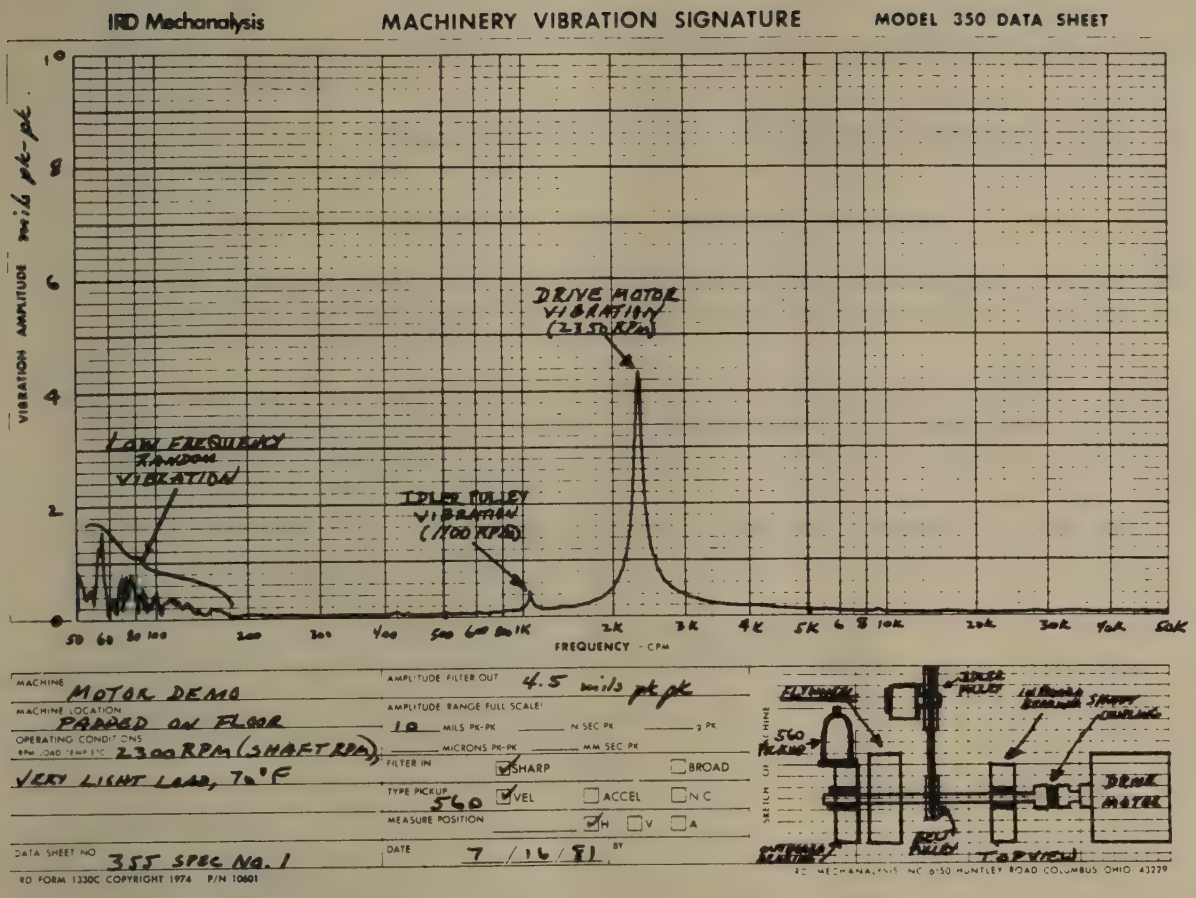

IRD Mechanalysis
MACHINERY VIBRATION SIGNATURE
MODEL 350 DATA SHEET
VIBRATION AMPLITUDE mils pk-pk
DRIVE MOTOR VIBRATION (2150 RPM)
LOW FREQUENCY RANDOM VIBRATION
IDLER PULLEY VIBRATION (1100 RPM)
FREQUENCY - CPM
MACHINE MOTOR DEMO
MACHINE LOCATION PARKED ON FLOOR
OPERATING CONDITIONS 2300 RPM (SHAFT RPM), VERY LIGHT LOAD, 70°F
AMPLITUDE FILTER OUT 4.5 mils pk pk
AMPLITUDE RANGE FULL SCALE
10 MILS PK-PK
FILTER IN SHARP BROAD
TYPE PICKUP 560 VEL ACCEL N C
MEASURE POSITION H V A
DATA SHEET NO 355 SPEC NO. 1
DATE 7/16/81
IRD FORM 1330C COPYRIGHT 1974 P/N 10601
FLYWHEEL
IDLER PULLEY
560 PICKUP
DRIVE MOTOR
SKETCH OF MACHINE
TOP VIEW
IRD MECHANALYSIS INC 0150 HUNTLEY ROAD COLUMBUS OHIO 43229

Figure 4-3 Typical Vibration Frequency Spectrum Plot

NOTE: If the frequency peaks in the spectrum do not exceed 1/3 Full Scale, a greater spectrum amplitude resolution can be obtained by switching the AMPLITUDE RANGE SELECTOR to the next lower (more sensitive) amplitude position.

If still greater amplitude resolution of some low amplitude peaks is desired, the AMPLITUDE RANGE SELECTOR can be set to one lower (more sensitive) amplitude position. In this case, some of the larger peaks will be above the full scale limit.

6. Identify the amplitude and frequency of all peaks of interest, and relate these to the rotating speeds of the various machine parts.

4.2.5 TIME BASE PLOT MEASUREMENT/ANALYSIS

To obtain a time base plot measurement and analysis of a machine vibration, proceed as follows:

1. Set up the analyzer for vibration measurement as instructed in Chapter III.

2. Select the proper transducer for the specific measurement to be carried out.

3. Attach the transducer to the rotating machine.

4. Set up and operate the Model 1082 XY Plotter and the Model 355 for obtaining a Time Base Plot as instructed in the XY Plotter operation manual.

A typical vibration amplitude plot of a rotating machine during the machine startup is shown in Figure 4-11. In a plot of this type, the machine criticals, natural frequencies, resonants, and beats should be identified.

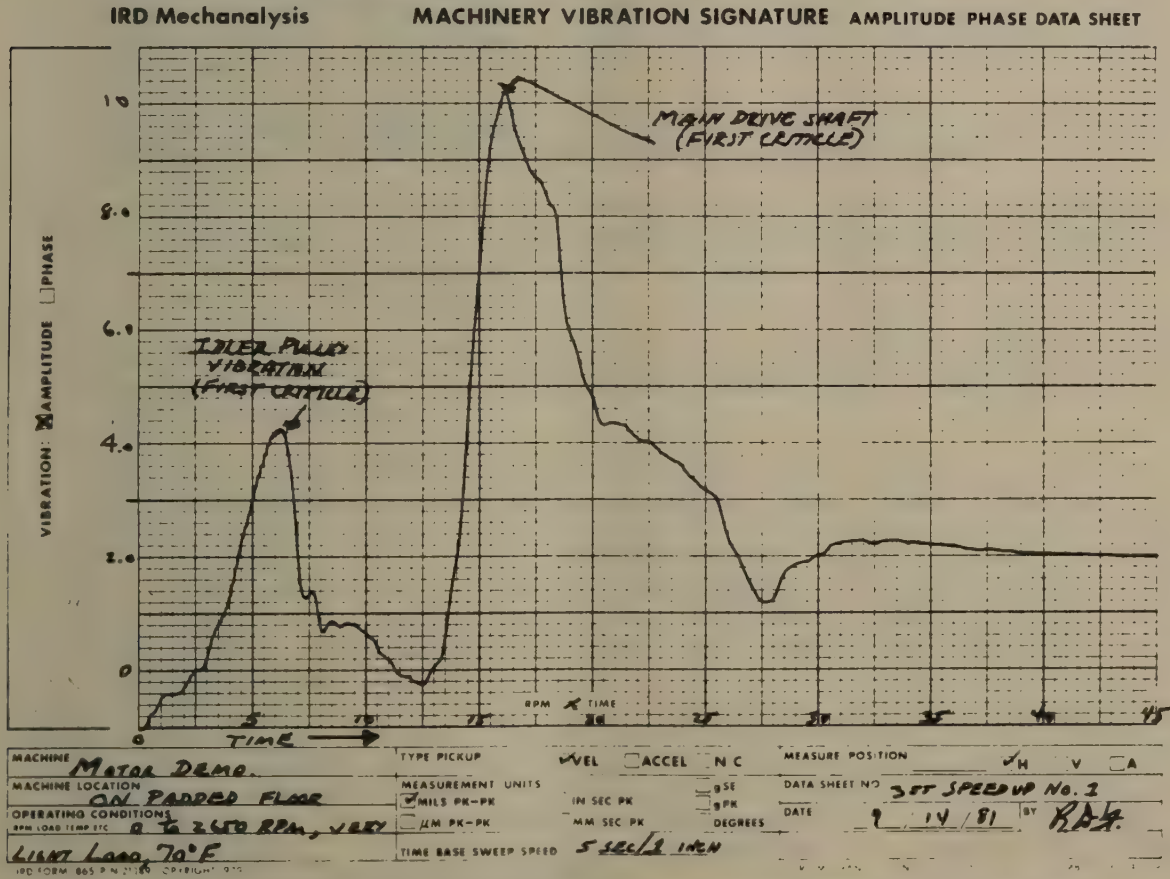


Figure 4-4 Typical Vibration Amplitude Time Base Plot During Machine Startup

4.3 SPIKE ENERGY MEASUREMENT AND ANALYSIS

The SPIKE ENERGY detection circuits in the Model 355 are designed to sense the amplitude of the microsecond range pulses caused by impacts between bearing or gear elements which have microscopic flaws. In addition to detecting pulse amplitude, these circuits also detect the rate of occurrence of the pulses and the amplitude of the high frequency random broad band vibratory energy associated with bearing and gear defects. These three parameters of pulse amplitude, pulse rate and high frequency random vibratory energy are electronically combined into a single quantity called "g-SE" which is a measure of bearing and gear condition. The term "g-SE" (i.e., acceleration units of SPIKE ENERGY) has been selected to indicate that this type measurement is more comprehensive than g-peak and g-RMS measurements.

The Model 355 instrument is also capable of passing the detected SPIKE ENERGY signals through the Broad, or Narrow filters to obtain a SPIKE ENERGY signature. By identifying the peaks in such signatures as being related to the machine bearings, or gears, the multiple sources of the SPIKE ENERGY, when present, can be pinpointed to the machine elements causing the peaks.

SPIKE ENERGY Amplitude - The procedure for measuring the amplitude of a machine SPIKE ENERGY is as follows:

1. Prepare the Model 355 analyzer for operation as instructed in Chapter III. (The Model 970 Accelerometer along with the 9-inch extender probe is used with the Model 355 to measure SPIKE ENERGY.)

2. Set the PICKUP SELECTOR to the ACCELerometer g-SE position, and the FILTER-OSC SELECTOR to the OUT (filter out) position.

3. Set the AMPLITUDE RANGE SELECTOR to 100, and while hand-holding the accelerometer with the tip of the extension probe held firmly to the machine bearing or gear housing where the SPIKE ENERGY is to be checked, progressively rotate the AMPLITUDE RANGE SELECTOR to more sensitive ranges until the AMPLITUDE METER indicator is positioned between the 1/3 full scale and the full scale positions.

NOTE: The value indicated on the AMPLITUDE METER is the filter out SPIKE ENERGY level at the selected measuring position. The SPIKE ENERGY should be measured at all associated bearing and gear housings, and the SPIKE ENERGY levels should be recorded. For details on evaluation of the SPIKE ENERGY severity, refer to Appendix C.

Spike Energy Signature - To obtain a Spike Energy Signature, proceed as follows:

1. Set up the analyzer for Spike Energy measurement and operation with an XY Plotter as instructed in Chapter III.

2. Install the Model 970 Accelerometer, and mount the 9-inch extension probe to the accelerometer.

3. Hand-hold the accelerometer to the machine so that the tip of the extension probe is held firmly on the desired bearing or gear housing.

4. To obtain the Spike Energy spectrum plot, set up and operate the Model 355 Analyzer and the XY Plotter as instructed in the XY Plotter operation manual. A typical Spike Energy spectrum plot is shown in Figure 4-5.

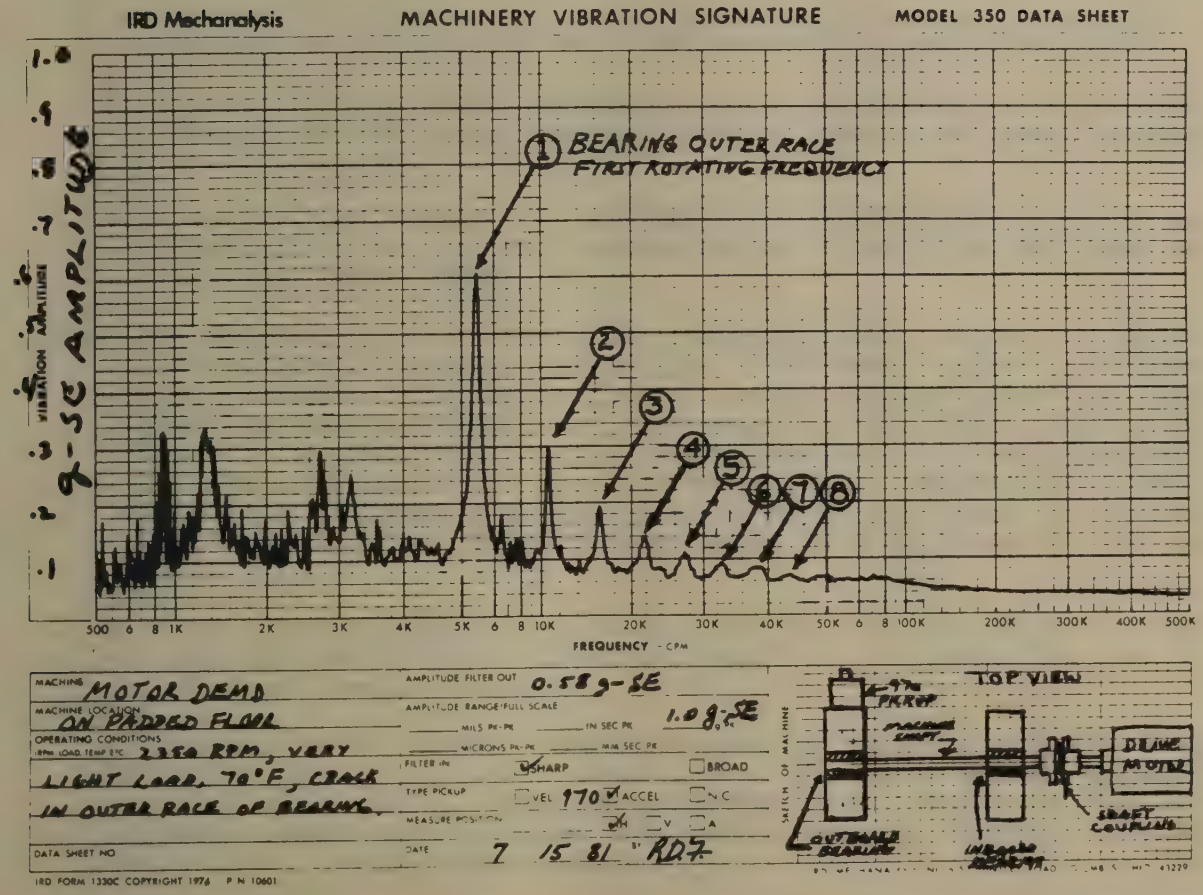


Figure 4-5 Typical Spike Energy Spectrum Plot

NOTE: If the Spike Energy peaks obtained in the spectrum do not exceed 1/3 Full Scale, a greater spectrum amplitude resolution should be obtained by switching the AMPLITUDE RANGE SELECTOR to the next one or two lower (more sensitive) amplitude positions.

5. Identify the frequency and amplitude of each Spike Energy peak, and relate these to the rotating speeds of corresponding bearing or gear parts (i.e., bearing inner and outer races, ball passing speeds, or gear teeth).

Spike Energy Time Base Plot - Still another method of presenting Spike Energy amplitude data is by means of a time base plot. This is accomplished as follows:

1. Set up the analyzer for Spike Energy measurement as instructed in Chapter III. (The Model 355 PICKUP SELECTOR should be set to ACCELerometer g-SE, and the FILTER-OSC SELECTOR should be set to OUT.)

2. Select the Model 970 Accelerometer, install the 9-inch extension probe, and the accelerometer signal input cable.

3. Hand-hold the accelerometer so that the tip of the extension probe is held firmly to the bearing housing or gear housing to be checked.

4. Set up the Model 355 AMPLITUDE RANGE SELECTOR so that an indication of 1/3 Full Scale to Full Scale is obtained on the AMPLITUDE METER.

NOTE: In setting up the AMPLITUDE SELECTOR, the filter-out Spike Energy level should be below the full scale value. In this type of plot, the Spike Energy levels may be recorded from numerous points throughout the machine, and care should be taken to select the plot time that provides the desired amount of plotting width for each measurement. Since the pickup probe is disconnected from the machine for each measuring position, the individual measurements will be apparent on the plot.

5. Set up and operate the Model 1082 XY Plotter and the Model 355 for obtaining a time-base plot as instructed in the XY Plotter operation manual.

A typical Spike Energy time-base plot is shown in Figure 4-6. In this type plot, the 9-inch probe should be held to each preselected bearing housing position for approximately 10 seconds, and then waiting an additional 10 seconds before applying it to the next position.

This sequential measurement of the bearings obtained during the time-base plotting will produce a series of flat-topped peaks, since each time the 9-inch probe is removed from the bearing the g-SE level will drop to zero. The flat top of each peak will indicate the Spike Energy (g-SE) level of each bearing.

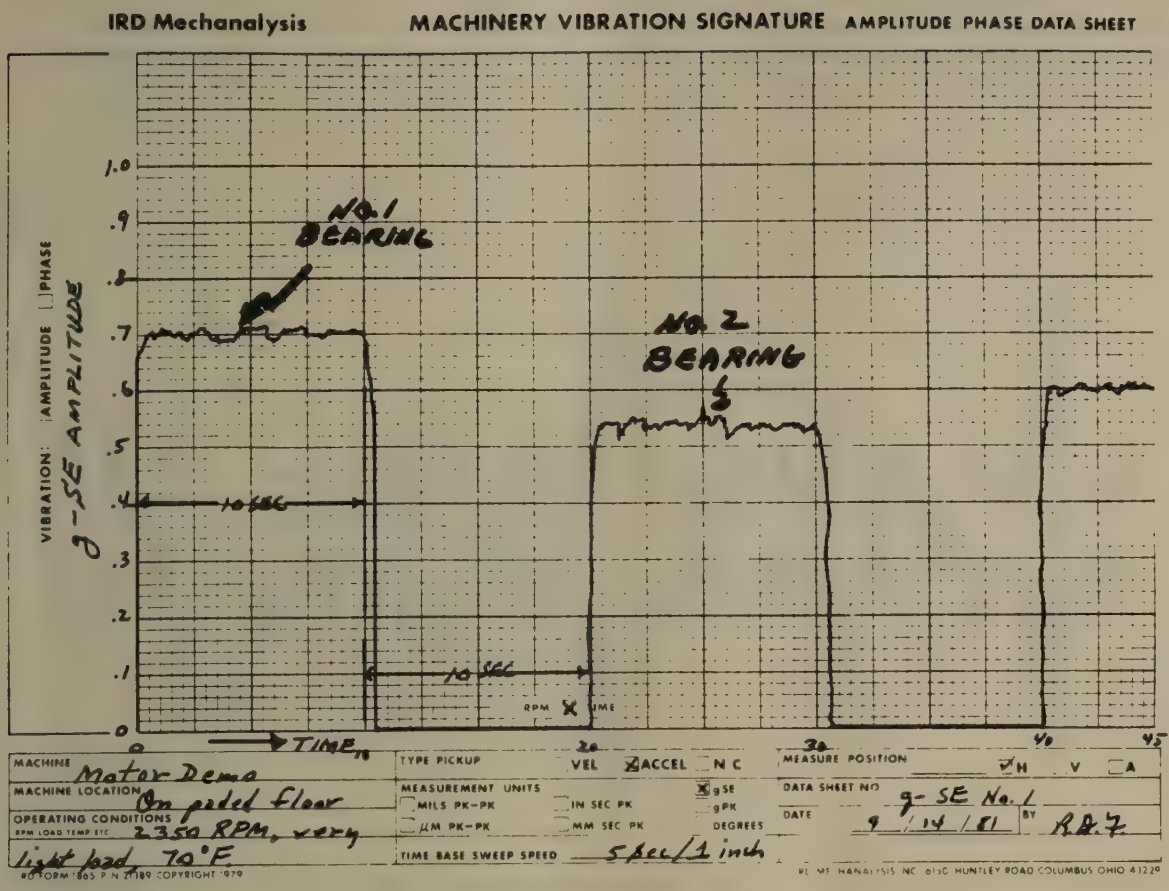


Figure 4-6 Spike Energy (g-SE) Amplitude Time-Base Plot

Oscilloscope Display of Spike Energy - If desired, a wavegram of the Spike Energy signal voltage can be displayed on an oscilloscope for analysis. This display is obtained by connecting the output at the Model 355 SCOPE receptacle (on the left-hand side panel) to the oscilloscope. A typical Spike Energy wavegram is shown in Figure 4-7.

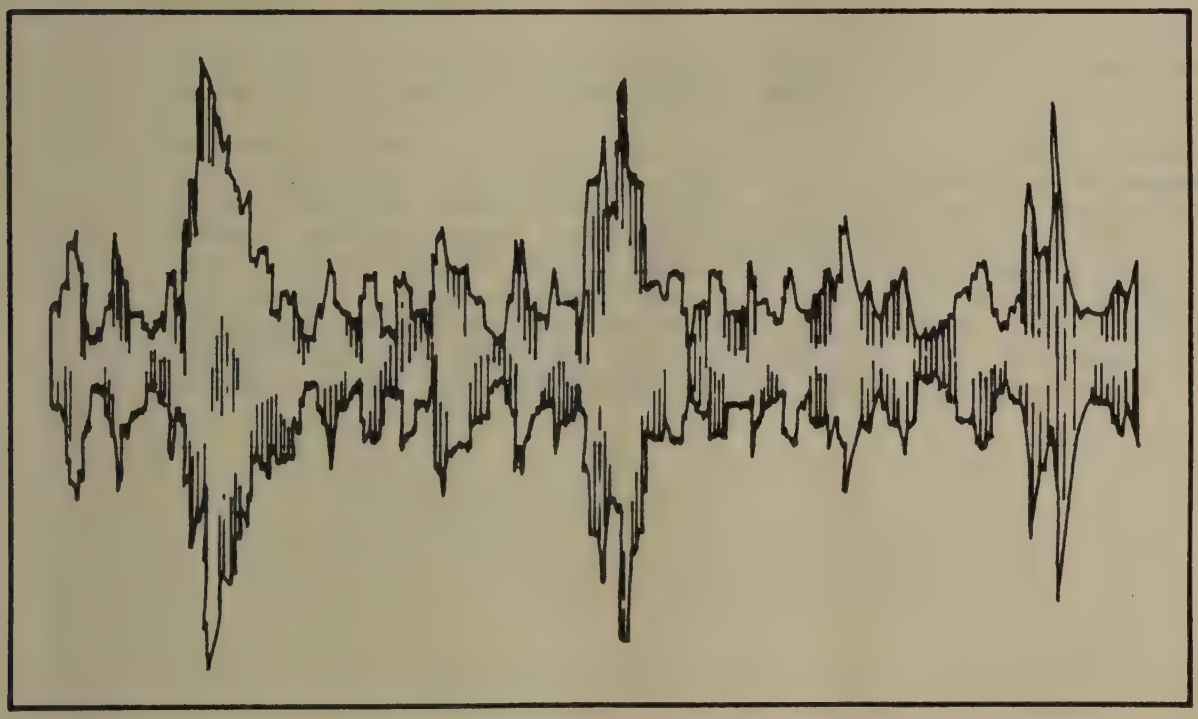


Figure 4-7 Spike Energy Scope Output Display

4.4 SOUND (NOISE) MEASUREMENT AND ANALYSIS

The optional Model 308 Vibration/Sound Level Meter is used with the Model 355 Analyzer to measure sound (noise) as follows:

1. Prepare the Model 355 and Model 308 instruments for sound measurement as instructed in Chapter III.

2. Locate the Model 308 so that it is correctly positioned to measure the sound. See the Model 308 operating Instruction Manual for details.

3. Set the Model 355 PICKUP SELECTOR to the VELocity IN/SEC peak position, and the AMPLITUDE RANGE SELECTOR of this instrument to 1 (10 for metric units).

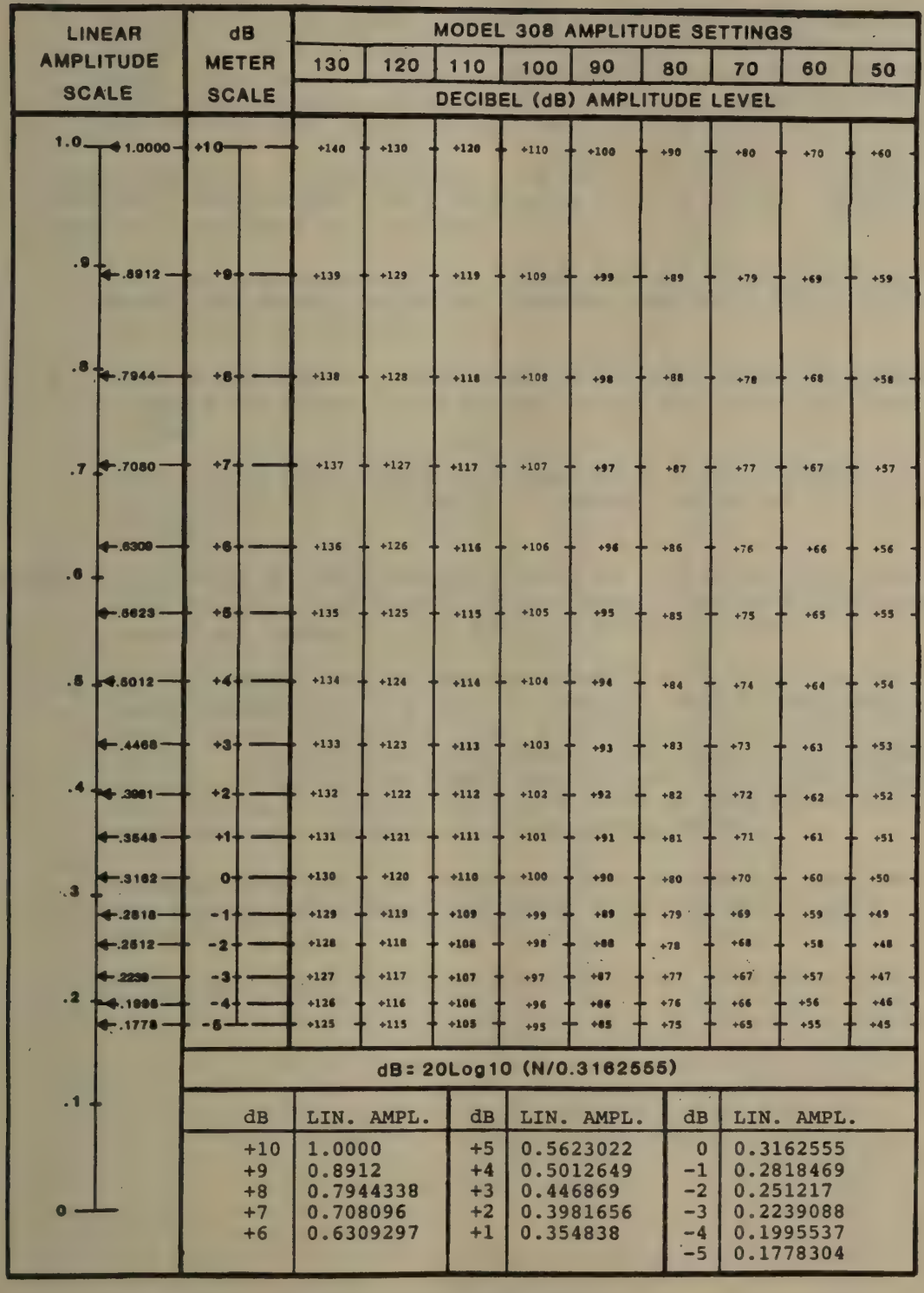
4. Set the Model 355 FILTER OSC SELECTOR to the OUT (filter out) position.

5. Adjust the AMPLITUDE SELECTOR of the Model 308 to obtain an AMPLITUDE METER indication of 1/3 Full Scale to Full Scale.

NOTE: The Model 355 AMPLITUDE METER should indicate approximately the same as the Model 308 Meter.

6. Read the relative dB level from the dB scale of either the Model 308 or Model 355 AMPLITUDE METERS.

7. Determine the filter out dB sound level from the table shown in Figure 4-7. In the table, find the point on the dB meter scale for the sound level read in Step 6, and the vertical column for the Model 308 AMPLITUDE SELECTOR setting used in Step 5 (the outer set of numbers on the Model 308 screening are used). Then project from the dB scale reading to the right to the column for the AMPLITUDE SELECTOR setting being used. The dB value at the intersection of the vertical column is the dB sound level of the sound being measured.



dB = 20Log10 (N/0.3162555)

dB	LIN. AMPL.	dB	LIN. AMPL.	dB	LIN. AMPL.
+10	1.0000	+5	0.5623022	0	0.3162555
+9	0.8912	+4	0.5012649	-1	0.2818469
+8	0.7944338	+3	0.446869	-2	0.251217
+7	0.708096	+2	0.3981656	-3	0.2239088
+6	0.6309297	+1	0.354838	-4	0.1995537
				-5	0.1778304

Figure 4-8 Chart for Determining dB Sound Level from Relative dB Amplitude

8. To obtain the sound pressure levels of the individual frequency components, proceed as was previously described in Section 4.2.2. PEAK TUNING MEASUREMENT/ANALYSIS. In this case, however, the linear amplitude levels measured on the AMPLITUDE METER will be converted to dB values by means of the conversion chart, Figure 4-7.

Sound (Noise) Spectrum Plot - When a graphical, rather than tabular, measurement and analysis of a sound spectrum is required, proceed as follows:

1. Set up the analyzer for sound (noise) measurement with a Model 308 Meter and an XY Plotter used with the analyzer as instructed in Chapter III.

2. Locate the Model 308 so that it is correctly positioned to measure the sound. For details, see the Model 308 operation manual.

3. Set up the XY Plotter for operation with the Model 355 as instructed in the operation manual supplied with the XY Plotter.

CAUTION: In the XY Plotter Manual, Step 17 (on Page 5 of the Model 1082 Manual, and Page 7 of the Model 1080 and 1081 Manuals) should be replaced with Step 4, which follows.

4. Set the Model 355 FILTER-OSC SELECTOR to OUT, the AMPLITUDE RANGE SELECTOR to 1 (10 in metric units) and the PICKUP SELECTOR to VELocity IN/SEC, peak (VEL mm/sec, peak in metric units). Then adjust the Model 308 AMPLITUDE SELECTOR to obtain an AMPLITUDE METER indication of 1/3 Full Scale to Full Scale. (Approximately the same amplitude should be indicated on the Model 355 AMPLITUDE METER.)

   Proceed with Step 18 in the XY Plotter manual (see Page 5 of the Model 1082 Manual and Page 7 of the Model 1080 or 1081 Manual.)

   A typical sound spectrum plot is shown in Figure 4-9.

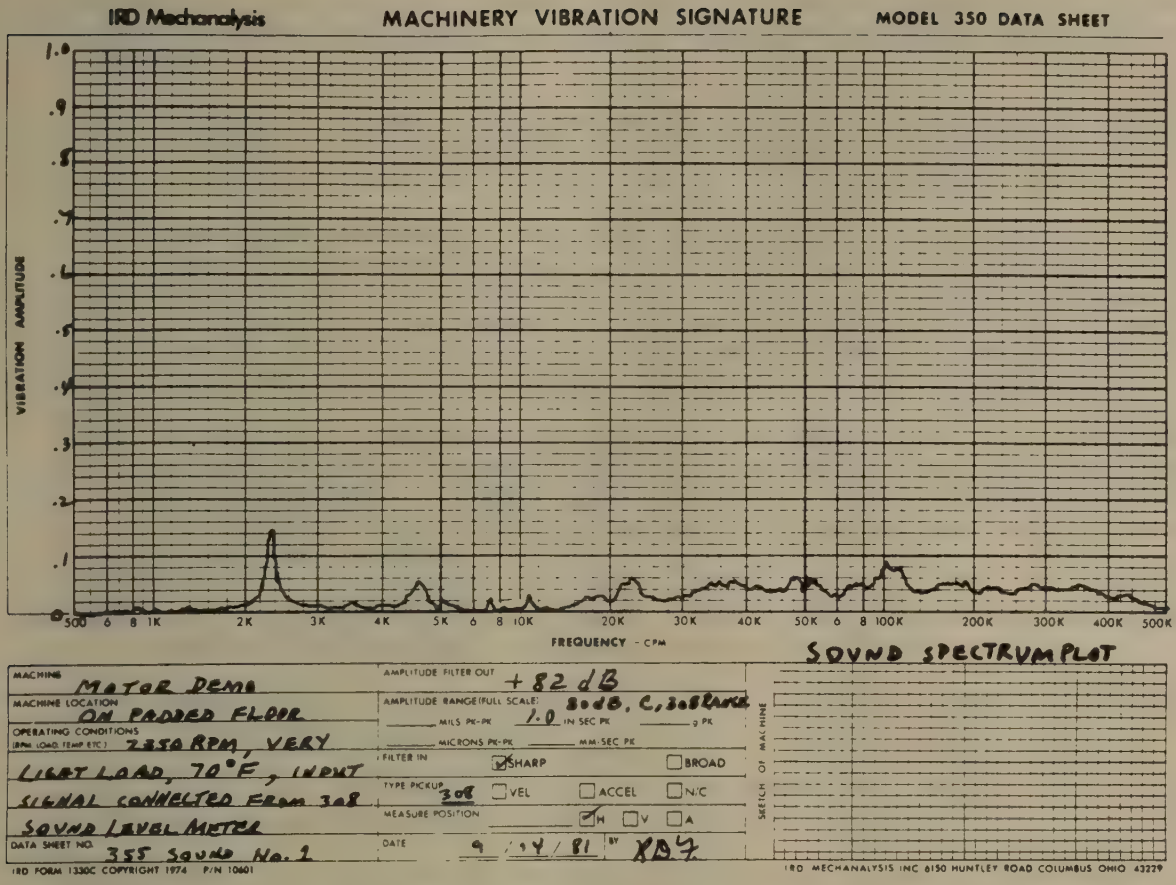

IRD Mechanalysis
MACHINERY VIBRATION SIGNATURE
MODEL 350 DATA SHEET
VIBRATION AMPLITUDE
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
500 6 8 1K 2K 3K 4K 5K 6 8 10K 20K 30K 40K 50K 6 8 100K 200K 300K 400K 500K
FREQUENCY - CPM
SOUND SPECTRUM PLOT
MACHINE Motor Demo
MACHINE LOCATION On Padded Floor
OPERATING CONDITIONS (RPM, LOAD, TEMP, ETC.) 7350 RPM, VERY LIGHT LOAD, 70°F, INPUT SIGNAL CONNECTED FROM 308 SOUND LEVEL METER
DATA SHEET NO. 355 Sound No. 1
AMPLITUDE FILTER OUT +82 dB
AMPLITUDE RANGE (FULL SCALE): 80dB, C, 308 Range
MILS PK-PK 1.0 IN SEC PK g PK
MICRONS PK-PK MM-SEC PK
FILTER IN SHARP BROAD
TYPE PICKUP 308 VEL ACCEL N/C
MEASURE POSITION H V A
DATE 9/14/81 BY KB7
SKETCH OF MACHINE
IRD FORM 1330C COPYRIGHT 1974 P/N 10601
IRD MECHANALYSIS INC 6150 HUNTLEY ROAD COLUMBUS OHIO 43229

Figure 4-9 Typical Sound Spectrum Plot

Although the spectrum lot will have a linear amplitude scale, the plotted units will be "dB" (decibels). The plot will show a full scale value of 1 (10 in metric units). The Full-Scale marker should be corrected to read the dB value to which the Model 308 AMPLITUDE SELECTOR is set plus 10 dB. For example, if the Model 308 AMPLITUDE SELECTOR is set to 80 dB, then the full scale value of the spectrum plot will be 90 dB. to mark the plot amplitude scale with the additional dB values, use the table given in Figure 4-7. In the table, locate the dB meter scale line for the various sound levels, and project from these points to the vertical column for the Model 308 AMPLITUDE SELECTOR setting used. The dB values listed in this column are the correct dB sound levels.

4.5 IN-PLACE BALANCING

Unbalance is the most common cause of rotating machine vibration and the Model 355 Analyzer can be used for in-place balancing as follows:

1. Install a phase reference mark on the rotating machine shaft or wheel. If feasible, also install a stationary angle reference disc on the machine as shown in Figure 4-4.

   The phase reference mark can consist of a chalk mark, or any distinctive machine mark, such as a shaft keyway. When the mark is placed at the end of a shaft, or wheel, it should originate at the center and extend radially to the outer edge at one side of the part. The same rotating speed must be used each time measurements are made during the balancing.

2. Fasten the vibration pickup to the machine at the position selected close to the vibrating part having the greatest displacement. Either the horizontal or vertical mounting direction can be used, which ever provides the highest vibration reading.

CAUTION: The vibration pickup must remain at the same mounting position throughout the balancing operations.

3. Start the rotating machine and allow it to come up to the normal operating speed.

4. Tune the analyzer filter to the rotating machine RPM speed by using the method explained in Section 4.2.3.

5. When the rotating shaft is "frozen", read the angular position of the phase reference mark from the stationary disc. Record the angular position and the vibration amplitude indicated on the AMPLITUDE METER. These two readings are the Original Unbalance values. In the example shown in Figure 4-10, the Original Unbalance values (values "O") are 8.0 mils and 160° phase angle.

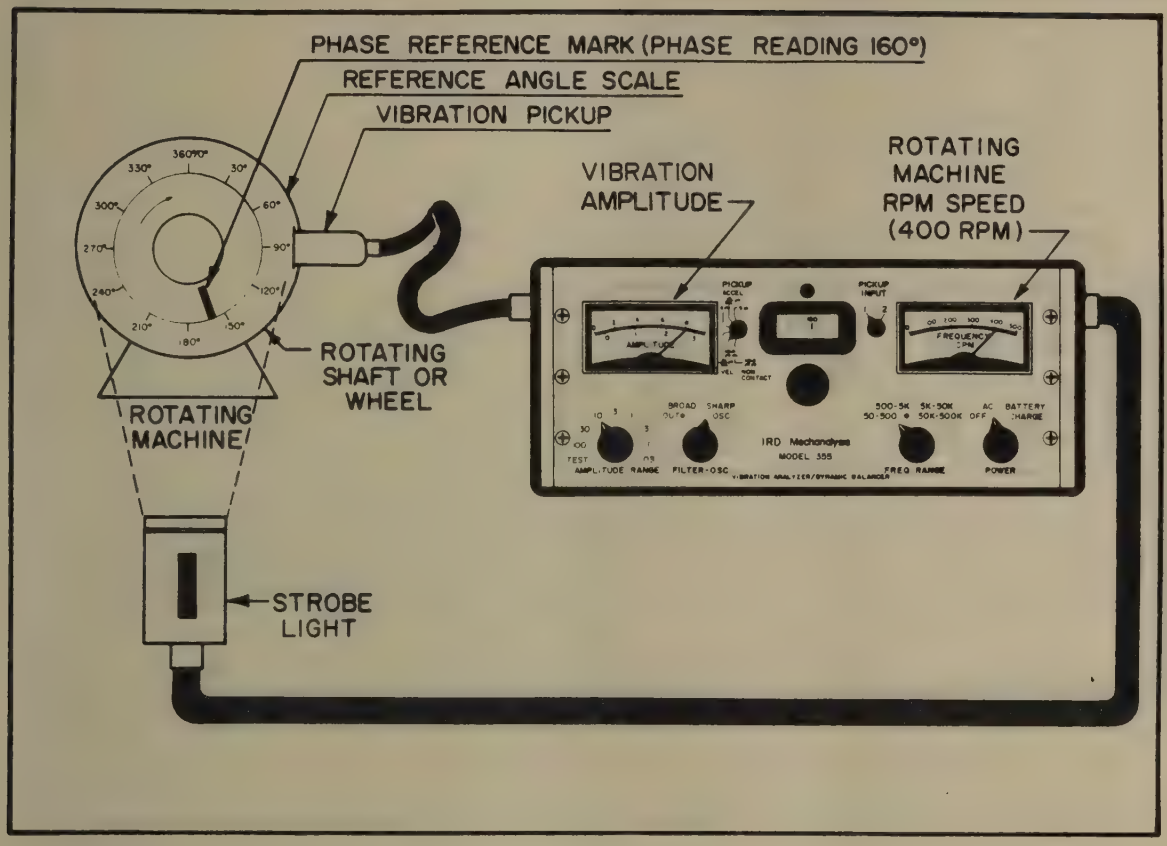


Figure 4-10 Original Unbalance Readings

6. Stop the rotating machine and install a "trial weight" at any location on the rotor.

CAUTION: Make certain that the "trial weight" and all additional weights are attached to the rotating part securely.

7. Restart the rotating machine, and allow it to come up to the normal operating speed. Then recheck the instrument filter for proper tuning, and retune if necessary.

8. When the rotating shaft is "frozen" again read the angular position of the phase reference mark from the stationary disc. Record the new angular position, and the vibration amplitude indicated on the AMPLITUDE METER. These two readings are the Original plus the Trial Unbalance values. In the example shown in Figure 4-11, the Original plus the Trial Unbalance (values "O+T") are 3.1 mils and 110° phase angle.

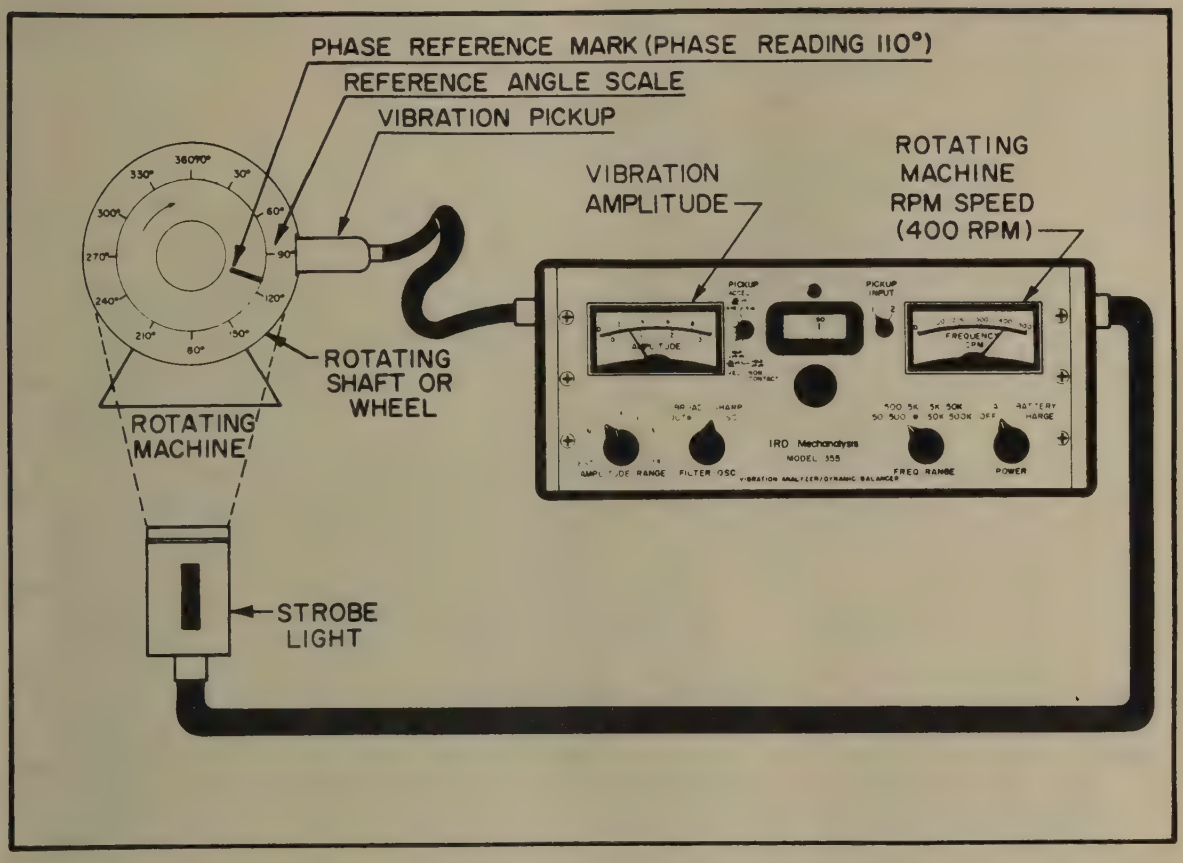


Figure 4-11 Unbalance Readings with Trial Weight Installed

9. On polar-graph paper, construct a vector diagram similar to the example diagram shown in Figure 4-12, but using the weight, angular values, and vibration amplitudes obtained in Steps 5 and 8 for the rotating machine part being balanced. Vector "O" is drawn from the values obtained in Step 5, and Vector "O+T" is drawn from the values obtained in Step 8. The outer end of each vector line ("O" and "O+T") are then interconnected, and labelled Line "T".

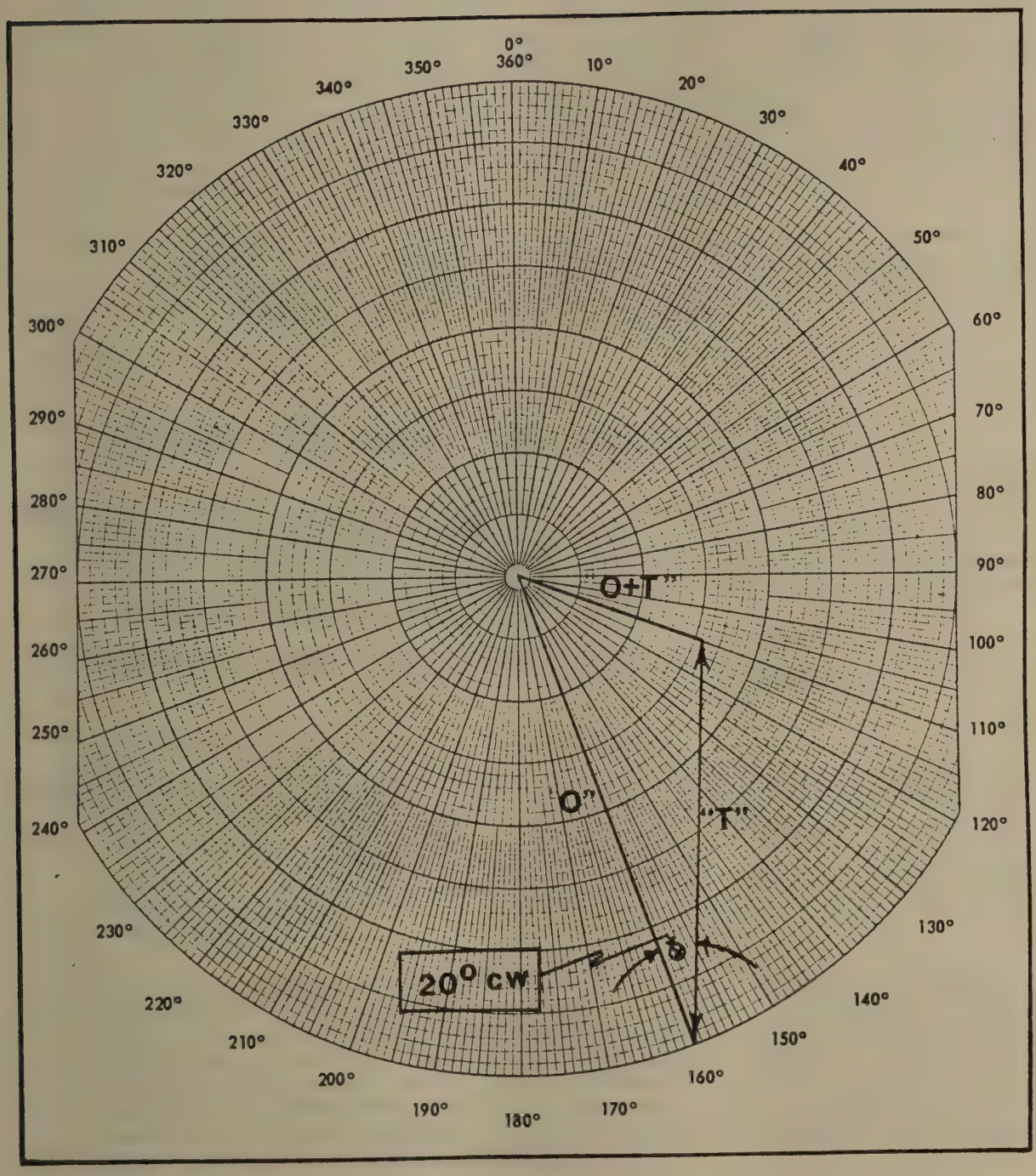


Figure 4-12 Sample Vector Diagram

10. Using a protractor, measure the angular distance from Line "O" to Line "T". Then shift the Trial Weight by this angular distance in the opposite direction from the shift of the Phase Reference Mark obtained in Step 8.

For example: in Figure 4-12, the angular distance from Vector "O" to Line "T" is 20°, and in Figure 4-10 the Phase Reference Mark shifted from 160°, the "original" position, to 110° the "original plus trial" position, shown in Figure 4-11. Since the Phase Reference Mark shifted in the counter-clockwise direction, the Correction Weight must be installed 20° in the clockwise direction from the original position used in Step 6.

11. Calculate the amount of Correction Weight required by multiplying the ratio of Vector "O" to the length of Line "T" (in terms of the measuring units being used) times the Trial Weight value as shown in Equation 1.

EQUATION 1:

$$\text{CORRECTION WEIGHT VALUE} = \text{TRIAL WEIGHT VALUE} \times \frac{O}{T}$$

NOTE: In Figure 4-10, the length of Line "T" is 6.5 mils and the length of Vector "O" is 8.0 mils. If the original Trial Weight weighed 5 ounces, then the final amount of Correction Weight required for balancing the rotating machine would be computed from Equation 1 as follows:

(1) $$\text{CORRECTION WEIGHT VALUE} = (5 \text{ ounces}) \times \frac{8. \text{ mils}}{6.5 \text{ mils}}$$

(2) CORRECTION WEIGHT VALUE = 6.15 ounces.

NOTE: The vector diagram may not be drawn with precise accuracy, and the vector lengths may not correspond exactly to the vibration amplitudes. Therefore, to compensate for possible error, one or additional TRIM BALANCE RUNS may be required to meet the required balancing tolerances. When performing a TRIM BALANCE RUN, the latest "O+T" value is to be compared to the original "O" value.

Trim Balancing - Use the Vector "O" value obtained in Step 5, and repeat the instructions given in Steps 7 through 11 until the required balancing tolerances are met. To perform the TRIM BALANCING RUN, the amount of unbalance remaining from the preceding balance run is to be plotted as the "O+T" value for the TRIM BALANCE RUN. This vector and the original Vector "O" should be interconnected, and the resulting line used as the Line "T" for the TRIM BALANCE RUN.

Detailed instruction and in-depth information on balancing are available through the IRD Mechanalysis, Inc., Audio-Visual Training Programs. Information regarding the training programs can be obtained by contacting your nearest IRD Mechanalysis representative, or by writing to IRD Mechanalysis, Inc., 6150 Huntley Road, Columbus, Ohio 43229, U.S.A.

V SERVICE

5.1 GENERAL

This chapter consists of the basic trouble shooting and maintenance information for the Model 355/355M Vibration Analyzer/Dynamic Balancer. Generally, the operational checks, etc., required can be performed by the instrument operator. For complete service information, contact your nearest IRD Mechanalysis Customer Service Agency. See the addresses in Section 5.5 of this manual.

5.2 FIELD MAINTENANCE

Field maintenance of the Model 355/355M instrument and accessories consists of the following operations which do not require the use of electronic test equipment:

A. Checking the interconnection cables for proper installation and operation.

B. Replacing the power fuses.

C. Checking the Model 355/355M instrument and accessories for proper setup.

Replacing AC Power Fuse

The AC power fuse is located on the right-hand side panel of the analyzer, and is readily accessible. It can be removed for checking or replacement by removal of the threaded red retainer from the fuse holder. A 1/2-ampere, 3AG SLO-BLO fuse, Part No. 1511 is used for 117 VAC operation (105 to 129 volts, 50/60/400 Hz), and a 1/4-ampere, 3AG SLO-BLO fuse, Part No. 5276 is used for 234 VAC operation (210 to 258 volts, 50/60/400 Hz). The fuse protects the analyzer circuits from the AC Power Line voltage.

CAUTION: Do not use a higher amperage fuse than listed as this could cause serious damage to the analyzer. If the fuse blows repeatedly, return the analyzer and accessories for service before using.

Checking Preparation and Setup

Instructions for preparing and setting up the Model 355/355M instrument and accessories for the standard operations are presented in Chapters III and IV. If satisfactory operation is not obtained, review these instructions, and make certain that the analyzer and accessories are prepared and set up correctly.

5.3 ORDERING REPLACEMENT PARTS

To order replacement parts, contact either your local IRD Customer Service Agency, or the IRD Mechanalysis home office, see addresses in Section 5.5. On your Purchase Order, specify the following information.

1. Model and complete Serial Number of instrument.

2. IRD Mechanalysis Part Number.

3. Name of part (capacitor, diode, resistor, etc.).

4. Reference Symbol (C101, D107, R321, etc.).

5.4 OBTAINING SERVICE

Before returning the instrument for repair, obtain service and shipping instructions from either your local IRD Service Agency or the IRD Mechanalysis home office (See addresses in Section 5.5). Package the instrument, velocity pickup, accelerometer, pickup cables, and extension cables inside a strong carton. Each article must be well padded. In addition, information should also be included giving details as to the nature of the problem or the service desired.

5.5 CUSTOMER SERVICE AGENCIES

USA

IRD MECHANALYSIS, INC.
6150 Huntley Road
Columbus, Ohio 43229
Phone: 614/885-5376
Telex: 24:5318

IRD MECHANALYSIS, INC.
8826 Interchange Drive
Houston, Texas 77054
Phone: 713/667-0941

IRD MECHANALYSIS, INC.
1131 Warren Avenue
Downers Grove, Ill. 60515
Phone: 312/960-4065

IRD MECHANALYSIS, INC.
Suite 202
3130 Maple Drive, N.E.
Atlanta, Georgia 30305
Phone: 404/237-4875

IRD MECHANALYSIS, INC.
Suite A2
221 So. Chester Pike
Glenolden, Penn. 19036
Phone: 215/461-7060

IRD MECHANALYSIS, INC.
Suite 4
3377 Mount Diablo Blvd.
Lafayette, Calif. 94549
Phone: 415/283-2065

CANADA

IRD MECHANALYSIS LIMITED
333 Barton Street East
Stoney Creek, (Hamilton)
Ontario, Canada L8E 2L1
Phone: 416/662-7577
Telex: 061-8453
Telex: 851-617034 IRD MECH G

IRD MECHANALYSIS LIMITED
Room 301
524 17 Avenue, S.W.
Calgary, Alberta
Canada T2S 0B2
Phone: 403/264-4130
Telex: 03-824680

UNITED KINGDOM

IRD MECHANALYSIS (UK) LIMITED
Bumpers Lane
Sealand Industrial Estate
Chester, United Kingdom CH1 4LT
Phone: Chester 44/244/374914-5
Chester 44/244/317557-8

WESTERN EUROPE

IRD MECHANALYSIS, S.A.
Avenue Winston Churchill 98
B1180 Brussels, Belgium
Phone: 32/2/344.70.58
32/2/344.72.18
Telex: 846-61256 IRD BRU B

FRANCE

IRD MECHANALYSIS France S.a.r.l.
23a, Rue Brongniart
F92310 Sevres
France
Phone: (1) 534 42 96

AUSTRALIA

IRD MECHANALYSIS (AUSTRALIA)
PTY. LTD.
337 Pacific Highway
Crows Nest, NSW 2065
Australia
Phone: (02) 929 8122
Telex: AA 23193

INDIA

IRD MECHANALYSIS (INDIA) LTD.
47/48 Jolly Maker Chambers II
Nariman Point
Post Office Box 991
Bombay 400 021, India
Phone: 230430
Telex: 953-11-3209 CIPL IN

5.6 MANUAL CHANGE RECORD

The following table lists all revisions included in this manual. The highest Change Letter listed in the table is also listed on the Face Page of the manual.

CHANGE LETTER	REVISION	DATE	ECO NO

APPENDIX A
SPECIFICATIONS
... FOR ...

Model 355/355M Vibration Analyzer/Dynamic Balancer

Model SP585 Strobe Light

Model 544 Velocity Pickup

Model 560 Velocity Pickup

Model 970 Accelerometer

Model 401 and 402 Non-Contact Pickups

Model 9251 Non-Contact Displacement Accessory

Model 9252 Non-Contact Displacement Accessory

Model 1080 Vibration Baseline Recorder

Model 1081 Vibration Baseline Recorder

Model 1082 Vibration Baseline Recorder

MEMORANDA

APPENDIX A

SPECIFICATIONS

This appendix consists of specifications for the Model 355/355M Vibration Analyzer/Dynamic Balancer, Model SP585 Strobe Light, Model 544 and 560 Velocity Pickups, Model 970 Accelerometer, optional Model 401/402 Non-Contact Pickups, optional Model 9251/9252 Non-Contact Displacement Accessory and the optional Model 1080, 1081, and 1082 Vibration Baseline Recorders.

MODEL 355/355M SPECIFICATIONS

FREQUENCY RANGE
- Displacement: 50 to 500,000 CPM
- Velocity: 50 to 500,000 CPM
- Acceleration: 50 to 500,000 CPM
- Spike Energy: Ultrasonic

FILTER RANGE
- 50 to 500,000 CPM

FILTER CHARACTERISTICS
- Broad: Filter bandwidth 10% Max. (Q = 10) at 3dB down
- Sharp: Filter bandwidth 5% Max. (Q = 20) at 3dB down

INTERNAL OSCILLATOR RANGE
- 50 to 500,000 CPM in four ranges: 50 to 500; 500 to 5000; 5000 to 50,000; 50,000 to 500,000 CPM

STROBOSCOPIC LIGHT
- One flash per cycle to 15,000 CPM; submultiple firing to 500,000 CPM

MEASUREMENT PARAMETERS
- With Model 970 Accelerometer
  - Velocity
  - Acceleration
  - Spike Energy
- With Model 544 Velocity Transducer
  - Displacement
  - Velocity
- With (Optional) Model 560 Low Frequency Velocity Transducer
  - Displacement
  - Velocity

DISPLACEMENT RANGE
- English: 0 to 100 mils in eight full-scale overlapping ranges: 0 to .03; 0 to .1; 0 to .3; 0 to 1; 0 to 10; 0 to 30; 0 to 100 mils peak-to-peak
- Metric: 0 to 3000 micrometers in eight full-scale overlapping ranges: 0 to 1; 0 to 3; 0 to 10; 0 to 30; 0 to 100; 0 to 300; 0 to 1000; 0 to 3000 micrometers peak-to-peak

VELOCITY RANGE
- English: 0 to 100 inches/sec in eight full-scale overlapping ranges: 0 to .03; 0 to .1; 0 to .3; 0 to 1; 0 to 3; 0 to 10; 0 to 30; 0 to 100 inches/sec peak
- Metric: 0 to 3000 millimeters/sec in eight full-scale overlapping ranges: 0 to 1; 0 to 3; 0 to 10; 0 to 30; 0 to 100; 0 to 300; 0 to 1000; 0 to 3000 millimeters/sec peak

ACCELERATION RANGE
- English and Metric: 0 to 100 g's in eight full-scale overlapping ranges: 0 to .03; 0 to .1; 0 to .3; 0 to 1; 0 to 3; 0 to 10; 0 to 30; 0 to 100 g peak (1 g = 386 inches/sec^2, or 980 cm/sec^2)

SE (SPIKE ENERGY) RANGE
- English and Metric: 0 to 100 g's SE in eight full-scale overlapping ranges: 0 to .03; 0 to .1; 0 to .3; 0 to 1; 0 to 3; 0 to 10; 0 to 30; 0 to 100 g's SE with special circuits designed to detect spike energy (SE)

SOUND ANALYSIS AMPLITUDE RANGE
- When used with Model 308 Vibration/Sound Level Meter
- English and Metric: 45 to 140 dB (re .0002 microbar or 20 micronewtons/meter^2)

TEST SIGNAL
- Internally generated test signal operates on AC or battery power—checks complete circuit operation

BATTERY TEST
- All batteries tested under load; battery condition indicated on meter scale

INPUTS
- Two input channels, switch selectable, with receptacles for use with 544, 560, or 970 transducers, non-contact/signal sensors with 200 mv/mil (7.9 mv/micron) sensitivity and Model 308 Vibration/Sound Level Meter.
- AC power Input Receptacle

OUTPUTS
- Two panel meters for readout of vibration level and frequency
- Filter Tuning Dial indicates frequency to which filter is tuned
- Scope/tape recorder AC output receptacle
- XY plotter output receptacles—DC outputs of amplitude and frequency
- AC power Outlet Receptacle
- Strobe Light Output Receptacle

METER DAMPING
- Amplitude and frequency meter damping automatically selected by filter frequency range switch

TEMPERATURE RANGE
- Storage: 0° to 150°F (−18°C to +65°C)
- Charging/A.C. Operation = 0° to 150°F (−18°C to +65°C)
- Battery Operation = 0° to 120°F (−18°C to +49°C)

PACKAGING
- Aluminum case with dust and splashproof seal
- Integral storage cover with standard accessories

DIMENSIONS
- Instrument: 7½" x 10" x 15½" (19 x 25 x 39 cm)
- Instrument with Storage Cover: 7½" x 15" x 15½" (19 x 38 x 39 cm)

WEIGHT
- Instrument: 20 pounds (9.1 kg)
- Instrument with Storage Cover and Standard Accessories: 34 pounds (15.4 kg)

POWER REQUIREMENTS
- 105/129 volts, 50/60/400 Hz, 25 watts (210/258 volts available upon request)
- Built-in Rechargeable Nickel Cadmium Battery Pack:
  - Instrument batteries: 12 hours continuous operation
  - Strobe batteries: 1 hour minimum continuous at maximum flash rate
  - Battery charge: Trickle or high rate

STANDARD ACCESSORIES
- 1—Model 544 Velocity Transducer, P/N 4526
- 1—12 ft. (3.7 m) Pickup Cable for Model 544 Transducer, P/N 20433
- 1—Model 970 Accelerometer, P/N 19697
- 1—12 ft. (3.7 m) Pickup Cable for Model 970 Accelerometer, P/N 20431
- 1—Straight Probe, P/N 1103
- 1—Model 569 Strobe Light, P/N 8650
- 1—12 ft. (3.7 m) Strobe Light Cable, P/N 8653
- 1—8 ft. (2.4 m) Power Cable, P/N 2501, with Adapter, P/N 1222
- 1—Instruction Manual, P/N 25075
- 1—Data Sheet Pad (Signature Plot), P/N 10601

Model 355—Calibrated in English Units
Model 355M—Same as 355, except calibrated in Metric units

- 1—Data Sheet Pad (Triaxial Signature Plot), P/N12619
- 1—Data Sheet Pad (Amplitude/Phase vs RPM/Time Plot), P/N21189
- 1—12ft.(3.7m) Non-Contact Monitor Pickup Cable.P/N24809 (BNC connector for connection to non-contact monitor output receptacle)

See Optional Accessory listing on Page A-2

MODEL 355/355M SPECIFICATIONS CONTINUED

OPTIONAL ACCESSORIES

- 25 ft. (7.6 m) Extension Cable for Model 970 Accelerometer, P/N 21044
- 50 ft. (15.2 m) Extension Cable for Model 970 Accelerometer, P/N 21048
- 25 ft. (7.6 m) Extension Cable for Model 544 Transducer, P/N 21045
- 50 ft (15.2 m) Extension Cable for Model 544 Transducer , P/N 21049
- Model 560 Low Frequency Velocity Transducer, P/N 24957
- 12 ft. (3.7 m) Pickup Cable for Model 560 Transducer, P/N 25136
- 25 ft. (7.6 m) Extension Cable for Model 560 Transducer, P/N 25137
- 50 ft. (15.2 m) Extension Cable for Model 560 Transducer, P/N 25138

- Magnetic Holder for Model 970 Accelerometer, P/N 24746
- Magnetic Holder for Model 544 and 560 Transducers, P/N 4332
- Magnetic Shield for Model 544 Transducer, P/N 10449

- XY Plotter:
  - Model 1080 (AC Power Only) (Amplitude vs Frequency Plots)
  - Model 1081 (AC and Battery Power) (Amplitude vs Frequency Plots)
  - Model 1082 (AC and Optional Battery Power) (Amplitude vs Frequency and Amplitude vs Time Plots)
- Non-Contact Displacement Accessories:
  - Single Channel, P/N 9251
  - Dual Channel, P/N 9252
- Model 308 Vibration/Sound Level Meter
- 12 ft. (3.7 m) Strobe Light Extension Cable, P/N 8653
- 12 ft. (3.7 m) Non-Contact/Signal Sensor Pickup Cable (two spade lug connectors for connection to signal sensor), P/N 22874
- Calibrator, P/N 21073
- Extra Strobe Light Bulb, P/N 8461
- Transit Case, P/N 10450

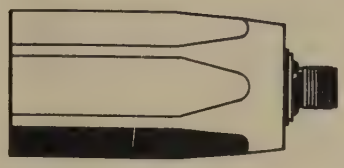
MODEL SP585 STROBE LIGHT SPECIFICATIONS

ITEM	SPECIFICATION
FREQUENCY RANGE	Direct firing from 10 to 5,000 CPM, and sub-multiple firing above 5,000 CPM to 500,000 CPM.
INPUT CONNECTION	Signal Input cable, 25-foot, permanently connected to the strobe light, and a BNC connector provided at external end for connection to the signal source.
AC POWER INPUT REQUIREMENTS	105 to 129 VAC, 50/60 Hz, 1-phase (or 210 to 258 VAC, 50/60 Hz, 1-phase if requested).
AC POWER CABLE	8-foot power cable with 3-prong plug for connection to the AC voltage supply receptacle.
AC POWER SWITCH	Power ON-OFF switch provided on the strobe light.
POWER FUSE	0.5 Amperes, 3AG, Slo-Blo (0.25 amperes, 3A-G Slo-Blo if designed for 210 to 258 VAC input).
INPUT SIGNAL	0.03 to 30 VAC, RMS, (adjustable sensitivity control built into strobe light).
SIGNAL PHASE	Light flashes at each positive-going zero-crossing input signal up to 5,000 CPM.
LIGHT BEAM WIDTH	Diameter approximately 24 inches at a flash distance of 10 feet.
SIZE	Length: 8-1/2 inches (21.6 cm). Width: 5 inches (13 cm). Height: 4 inches (10 cm).
WEIGHT	Instrument: 5 pounds (3 Kg). Shipping Weight: 10 pounds (6 Kg).

MODEL 544 VELOCITY PICKUP SPECIFICATIONS

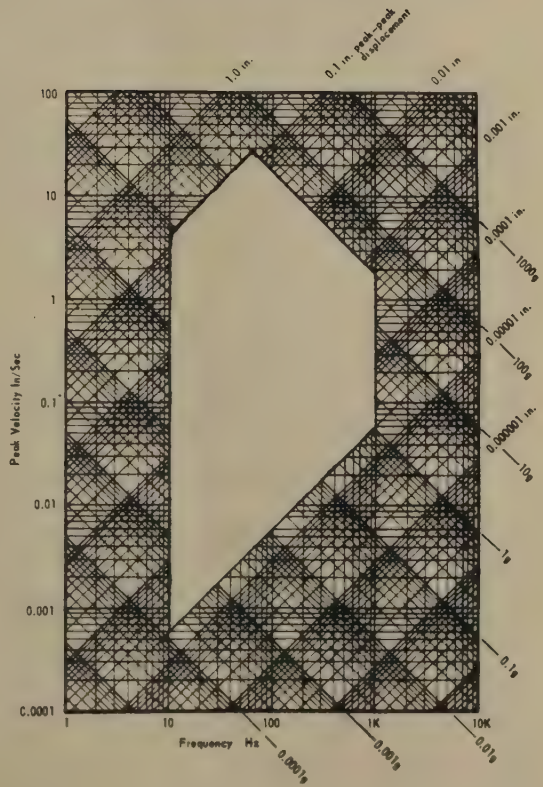
DESCRIPTION

The Mechanalysis Model 544 Vibration Pickup is a seismic velocity transducer, consisting of a moving coil in a permanent magnetic field, with eddy-current damping. This pickup is suitable for a wide variety of manual and continuous monitoring applications due to its high output, low impedance wide frequency response, and rugged construction. The anodized aluminum housing is waterproof, dustproof, and acceptable for use in Division 2 hazardous areas. A variety of accessories are available.



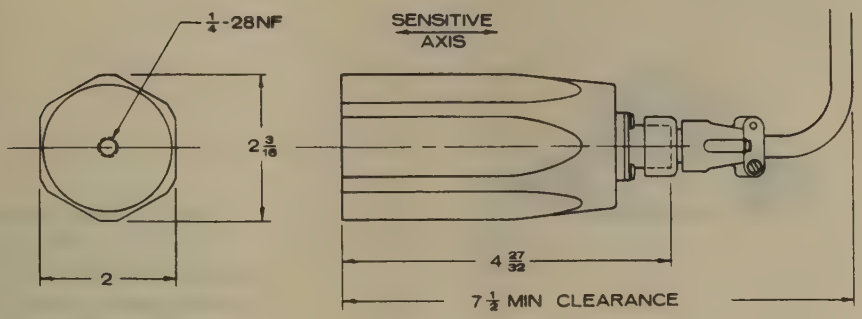
SPECIFICATIONS

Frequency Range:	12 Hz - 1000 Hz ± 8% -8% +13% @ 10 Hz
Sensitivity:	764 ± 10% Mv RMS/in/sec (peak)
Temperature Range:	-40°F to +500°F
Impedance:	R = 2Kohms; L = 0.7 Hy
Damping Factor:	0.7 (critical)
Orientation:	Any
Transverse Response:	Less than 5% (average) between 10 Hz and 1000 Hz
Magnetic Field Sensitivity:	0.15 inches/sec/gauss
Housing:	Waterproof, dustproof
Connector:	2-pin 732S-10SL-4P
Weight:	21 oz
Grounding:	Case and signal ground common
Mounting:	1/4 - 28 tapped hole, 1/4 deep
Max Amplitudes:	125 mils pk-pk to 70 Hz; 30g above 70 Hz



MODEL 544 VELOCITY PICKUP SPECIFICATIONS CONTINUED

OUTLINE DIMENSIONS



INSTALLATION

1. Sensitive axis may be oriented in any direction
2. Mounting surface must be flat, smooth, at least 2 3/8 in. dia.
3. Mounting stud axis must be perpendicular to mounting surface
4. Pickup should be installed hand-tight
5. Connector pin A is signal ground and housing ground; pin B is signal.

ACCESSORIES (see Spec Sheets for detailed information)

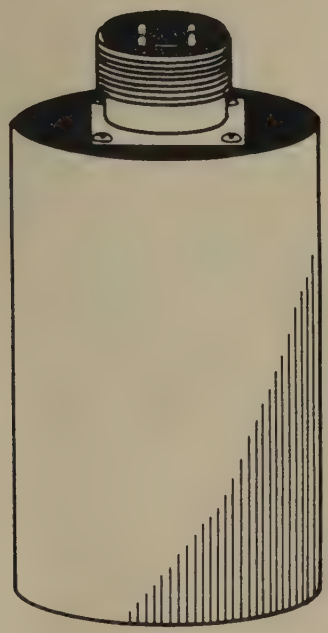
1. Magnetic Shields—to reduce sensitivity to A.C Magnetic Fields by 100:1 P/N 10449 (See Spec Sheet 43-02)
2. Explosion-proof Enclosure—for installations in Division 1, Class I, Group D or Class II Groups E, F, G Hazardous Areas P/N 4224 (See Spec Sheet 72-01)
3. Safety Barrier—for intrinsically safe installations in Division 1, Class I, Groups B, C, D Hazardous Areas P/N 7685 (See Spec Sheet 43-02)
4. Straight Cable Connector P/N 4366 (Rated for continuous operation at 200°F or 93°C)
5. Straight Cable Connector P/N 15039 (Rated for continuous operation at 500°F or 260°C)
6. Right Angle Connector P/N 14797 (Rated for continuous operation at 200°F or 93°C)

ORDERING INFORMATION

(qty) P/N 4526 Model 544 Vibration Pickup

(qty) P/N 4366 Cable Connector

MODEL 560 VELOCITY PICKUP SPECIFICATIONS



DESCRIPTION

The IRD Model 560 is a unique piezoelectric seismic velocity transducer designed specifically for low frequency applications. It has a flat frequency response ±10% from 1 Hz to 4.5 KHz. The high upper frequency limit makes it suitable for general machinery vibration measurements, as well as low frequency, while its built-in electronics provide a high output sensitivity and low impedance to enable it to drive long cables.

The low residual noise combined with low phase shift make it an ideal transducer for low speed balancing applications.

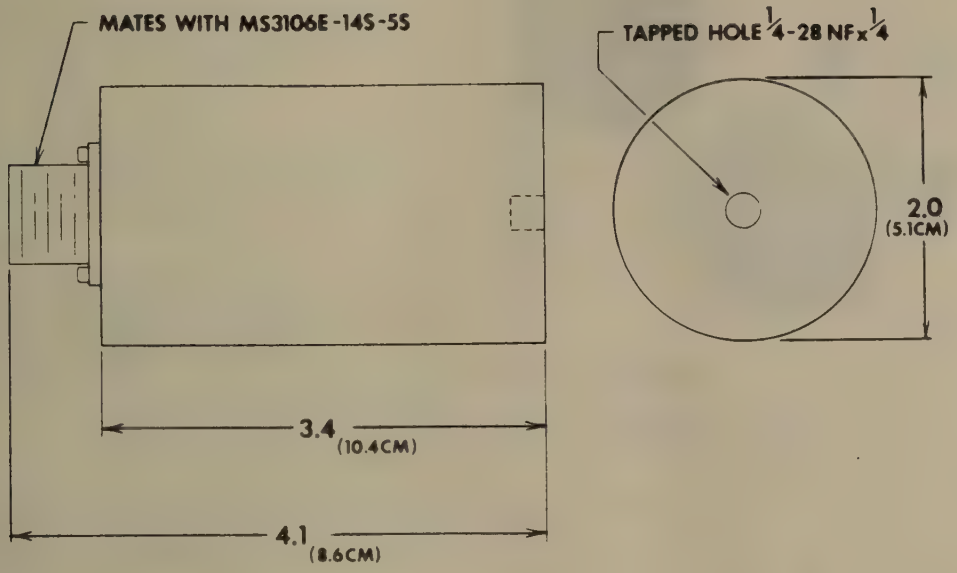
The Model 560 is designed to be waterproof, and is constructed of stainless steel with a ¼-28 tapped hole for stud mounting.

SPECIFICATIONS AT +75°F (+24°C)

Frequency Range:	Flat ±10% from 1 Hz to 4.5 kHz
Maximum Usable Amplitude (undistorted):	5 in/s peak
Residual Noise:	.0007 equivalent in/s broad band
Weight:	38 oz (1079 grams)
Size:	2" dia. O.D. 4" ht. (including receptacle)
Temperature Range:	−40°F to +250°F (−40°C to +121°C)
Output Units:	Velocity
Velocity Sensitivity:	1080 mv/in/s ±5% at 100 Hz
Magnetic Field Sensitivity:	10^{-5} in/s/Gauss equivalent
Transverse Response:	5% maximum @ 10 Hz, 5 g peak
Max. Continuous Vibration:	250 g pk
Maximum Shock:	500 g pk
Mounting:	Centered ¼"-28 x ¼ deep hole
Mounted Natural Freq:	10K Hz minimum
Water Resistance:	Waterproof
Connector:	Top mounting, 5 pin M.S.
Grounding:	Case isolated from signal ground
Power Input:	±15 Vdc at ±5 mA maximum
Cable Drive Capability:	Drive 500 ft. (25,000 pF) cable without clipping of 1 kHz 5 in/s signal
Phase Shift:	10° at 7 Hz, 30° at 3 Hz maximum
Electronics:	Built-in amplifier

MODEL 560 VELOCITY SPECIFICATIONS CONTINUED

OUTLINE DIMENSIONS



INSTALLATION NOTES:

1. Mounting surface must be flat and smooth.
2. Install with light coating of silicone grease on mating surfaces.
3. Use ¼-28 stud mounting for permanent installation.
4. Use Magnetic Holder, P/N 4332, for temporary installation.

ORDERING INFORMATION:

(Qty) P/N 24957 Model 560 Vibration Pickup
(Qty) P/N 24953 Mating Connector (MS 3106E-14S-5S) for Model 560

MODEL 970 ACCELEROMETER SPECIFICATIONS

The IRD Model 970 is a rugged low impedance accelerometer type vibration pickup for use with portable instruments on all types of rotating machinery.

The Model 970 has built-in electronics to provide low impedance output and eliminate the need for special low noise cables. The Model 970 is sealed against dust and moisture and operates up to a temperature of 250°.

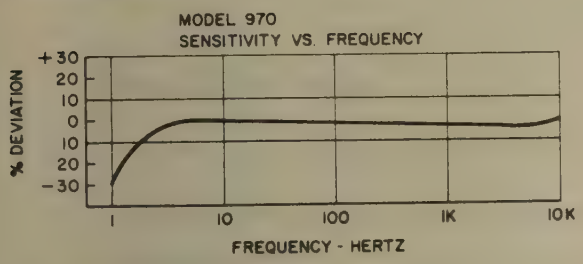
A single 1/4-28 mounting stud is used for attaching the pickup to a flat machine surface. Insulated Mounting Adapters are available for those cases where ground potential problems may exist between the pickup mounting surface and instrument.

The Model 970 connect directly to IRD Model 810, 840, 880 and other IRD instruments designed to accept the 970. Operating power is obtained from the instrument.

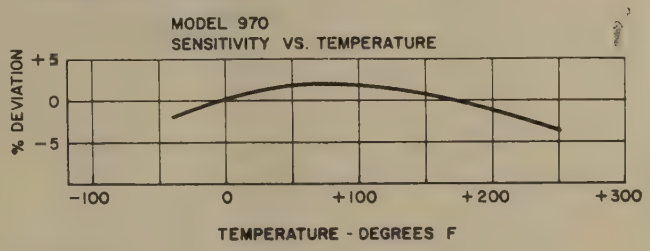
SPECIFICATIONS:

Sensitivity: 50 mV/g Nominal

Frequency Response:



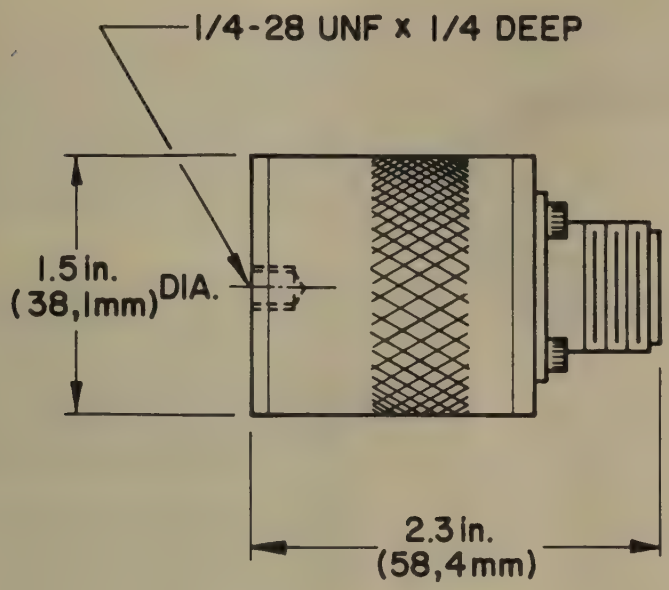
Temperature Response:



Mounted Resonant Frequency:	27K Hz Minimum
Maximum Usable Amplitude: (Undistorted)	180 g peak up to 1 k Hz 120 g peak at 5K Hz, or 70 g peak at 10 K Hz with ± 15v power supply and 25 ft. of 50 pF/ft. cable. Longer cables may be used with some reduction in maximum amplitude and/or high frequency response.) (Maximum amplitude is reduced proportionally at lower supply voltage)
Maximum Vibration: (without damage)	1000 g peak sinusoidal vibration
Maximum Shock: (without damage)	2000 g peak (10 ms half-sine)
Orientation:	Any
Tranverse Response:	5% Maximum, 3 % Typical
Magnetic Field Sensitivity:	Less than .0001 equiv. g/Gauss at 60 Hz
Residual Noise:	Less than .0002 equiv. g broadband — transducer output.
Grounding:	Case isolated from signal ground
Power Supply:	Regulated ± 8 Vdc @ ± 1.2 ma max. to ± 15 Vdc @ ± 1.75 ma max.
Housing:	300 series stainless steel, waterproof, dustproof, welded case
Connector:	4 Pin MS Type 12s-10P
Weight:	7.7 oz. (220 gr.)
Mounting:	1/4-28 Tapped Hole, 1/4" Deep

MODEL 970 ACCELEROMETER SPECIFICATIONS CONTINUED

OUTLINE DRAWING



INSTALLATION NOTES

1. Mounting surface must be flat and smooth, mounting stud must be square with surface and must not exceed 1/4" length.
2. Install with light coating of silicone grease on mating surface, tighten to 30-50 inch-pounds torque.
3. Connector Pin A + DCV power supply, Pin B — DCV power supply, Pin C is signal and power supply common, Pin D signal output.

ACCESSORIES

Insulated Mounting Stud (See Spec Sheet 43-08)

Magnetic Holder P/N 4332

Straight Probe P/N 1103

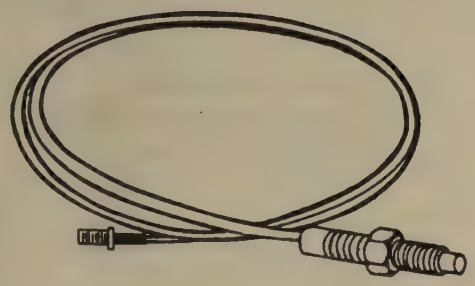
ORDERING INFORMATION

(Qty.) P/N 19697 Model 970 Vibration Pickup

MODEL 401 and 402 NON-CONTACT PICKUP SPECIFICATIONS

DESCRIPTION

Mechanalysis Non-Contact Pickups provide direct measurement of displacement. These pickups are used to measure radial shaft displacement where bearing housings are relatively stiff, such as in high speed centrifugal machinery. Non-Contact Pickups are also used to measure static or slowly varying distances such as axial shaft movement. In all cases, material to be measured must be metallic.



Non-Contact Pickups must be used with Coaxial Cables (Spec. Sheet 42-02) and Signal/Sensors (Spec. Sheet 62-03) to form a complete pickup system. Outputs from the system are (a) a D.C. signal proportional to average gap between pickup tip and sensed surface and (b) a dynamic A.C. signal corresponding to motion of the sensed surface. Vibration monitors, analyzers and similar equipment are used for readout and alarm functions.

Non-Contact Pickups with integral leads are available in a variety of standard sizes having two basic gap ranges based on body diameter.

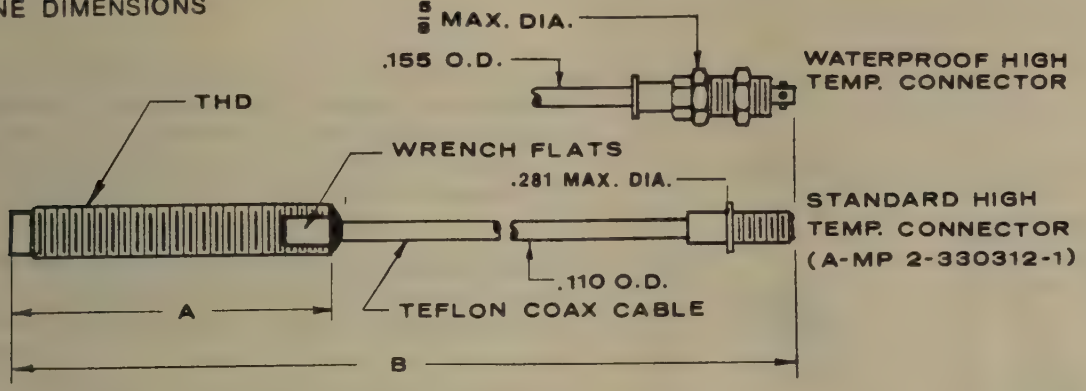
Special pickups can be made to meet user requirements.

SPECIFICATIONS

Gap Range:	40-80 mils (.040 - .080 in.) Model 402 15-45 mils (.015 - .045 in.) Model 401
Standard Calibration:	SAE 4140 Steel
Ambient Temperature Range:	0°F to +250°F
Isolation:	Coil isolated from body
Construction:	Stainless steel body; insulated tip, teflon cable
Environment:	Pickups are waterproof and oiltight. Waterproof connectors are available.

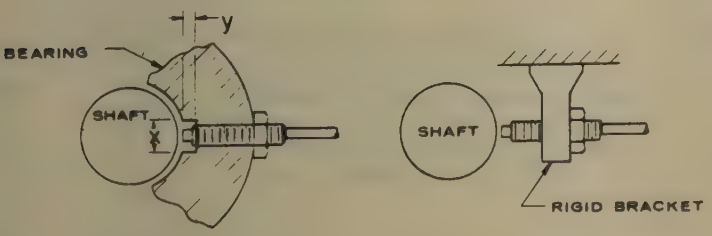
MODEL 401 and 402 NON-CONTACT SPECIFICATIONS

OUTLINE DIMENSIONS



Pickup Length-In. A	Overall Length-In. B	Gap Range Mils	Thread	Pickup Part No. Standard Connector	Waterproof Connector
1.0	13.0	40-80	3/8-24	8130	
2.0	13.0	40-80	3/8-24	8129	8662
7.0	13.0	40-80	3/8-24	8128	
1.0	37.0	40-80	3/8-24	8246	
2.0	37.0	40-80	3/8-24	8248	9296
7.0	37.0	40-80	3/8-24	8250	
0.8	9.5	15-45	1/4-28	8127	
0.8	36.5	15-45	1/4-28	8237	

INSTALLATION



MINIMUM TIP CLEARANCES		
THD	X	Y
3/8-24	.812	.300
1/4-28	.500	.165

ORDERING INFORMATION

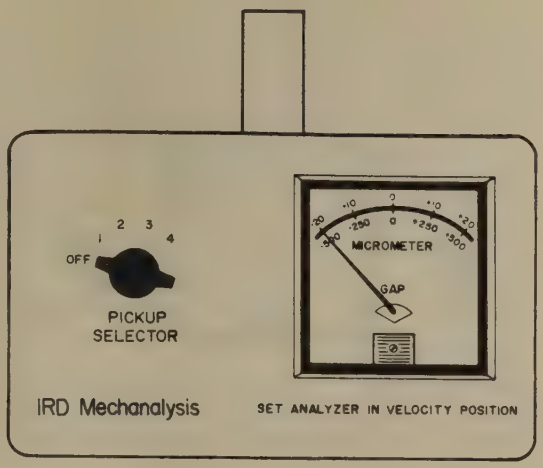
(qty) P/N _____ Non-Contact Pickup

MODEL 9251 NON-CONTACT DISPLACEMENT ACCESSORY SPECIFICATIONS

In order to determine the condition of many high speed machines, it is necessary to accurately measure shaft motion. This requirement can best be accomplished by using the IRD Non-Contact Displacement Accessory Part No. 9251, with any portable IRD instrument equipped to measure vibration velocity.

In combination with a portable IRD Analyzer/Dynamic Balancer, this unique Accessory uses non-contact pickups to measure shaft position and shaft vibration simultaneously.

This unit consists of a brushed aluminum anodized housing with a graduated gap meter and selector switch, and 8′ power cord, and one (1) non-contact pickup with 30′ separate pickup cable. Additional pickups and cables are optional.



SPECIFICATIONS

Channels: One (1) output with four pickup inputs, selectable by pickup selector switch.

Meter: ±20 mil scale reads mean gap; zero center scale reads nominal 60 mil gap.

Displacement Output:
- One (1) output.
- Output calibrated for 763 mv RMS @ 100 Hz for a one mil peak-to-peak displacement to be compatible with IRD Analyzers.
- Output displacement range: 0 to 20 mil peak-to-peak.
- Frequency Range: 150 to 500,000 CPM

D.C. Gap Outputs:
- One output for calibration.
- Output range ±20 mils.
- Output D.C. voltage variation approximately +4 to +8 volts over the ±20 mil range. Nominal gap of 60 mils, output voltage set to +6 volts.

Operating Temperatures:
Pickup and Cable 30° to 25°F.
0° to 121°C.
Accessory 32° to 150°F.
0° to 66°C.

Power: 105 to 129 volts (or 210 to 258 volts) 50/60/400 Hz at approximately 25 watts.

Dimensions: Approximately 4″ high x 6½″ long x 7″ deep. (10.2cm high x 16.5cm long x 17.8cm deep)

Shipping Weight: Approximately 10 lbs. (4.5 Kgm)

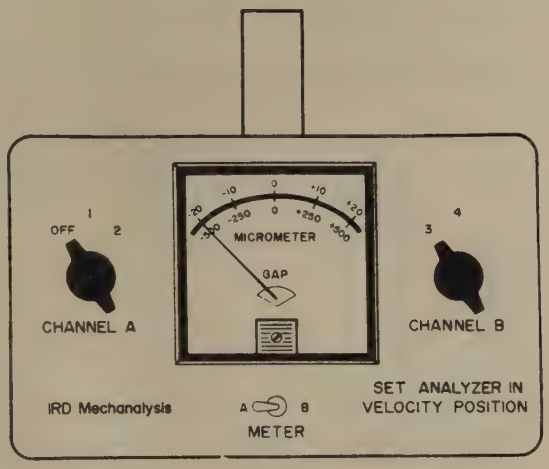
Standard Accessories:
- One (1) Non-Contact Unshielded Pickups, 60 mil nominal gap, Part No. 8248
- One (1) 30′ Non-Contact Pickup Cable with Connectors, Part No. 5347
- One (1) 8′ Power Cord, Part No. 2914

MODEL 9252 NON-CONTACT DISPLACEMENT ACCESSORY SPECIFICATIONS

In order to determine the condition of many high speed machines, it is necessary to accurately measure shaft motion. This requirement can best be accomplished by using the IRD Non-Contact Displacement Accessory Part No. 9252, with any portable IRD instrument equipped to measure vibration velocity.

In combination with a portable IRD Analyzer/Dynamic Balancer, this unique Accessory uses non-contact pickups to measure shaft position and shaft vibration simultaneously. Shaft orbital path (Lissajous) patterns can also be obtained when the combination is used with an oscilloscope.

This unit consists of a brushed aluminum anodized housing with a graduated gap meter and selector switch, an 8′ power cord, and two (2) non-contact pickups with 30′ separate pickup cables. Additional pickups and cables are optional.



SPECIFICATIONS

Channels: Two (2) separate output channels, A and B, permits Lissajous pattern presentation of dynamic signal.
Four pickup inputs, two per channel; selectable by pickup selectors for each channel.

Meter: ±20 mil scale reads mean gap; zero center scale reads nominal 60 mil gap.

Meter Selector Switch: Two position selects channel A or channel B pickup mean gap for meter readout.

Displacement Output:
- Two separate outputs, channel A & B
- Each output calibrated for 763 mv RMS @ 100 Hz for a one mil peak-to-peak displacement to be compatible with IRD Analyzers.
- Each output displacement range: 0 to 20 mil peak-to-peak
- Frequency Range: 150 to 500,000 CPM

D.C. Gap Outputs:
- Two separate outputs for each channel (A and B) for calibration.
- Each output range ±20 mils
- Each output D.C. voltage variation approximately +4 to +8 volts over the ±20 mil range. Nominal gap of 60 mils, output voltage set to +6 volts.

Operating Temperatures:

Pickups and Cables	30° to 250°F. 0° to 121°C.
Accessory	32° to 150°F. 0° to 66°C.

Power: 105 to 129 volts (or 210 to 258 volts)
50/60/400 Hz at approximately 25 watts.

Dimensions: Approximately 4″ high x 6½″ long x 7″ deep. (10.2cm high x 16.5cm long x 17.8cm deep)

Shipping Weight: Approximately 10 lbs. (4.5 Kgm)

Standard Accessories:
- Two (2) Non-Contact Unshielded Pickups, 60 mil nominal gap, Part No. 8248
- Two (2) 30′ Non-Contact Pickup Cables with Connectors, Part No. 5347
- One (1) 8′ Power Cord, Part No. 2914

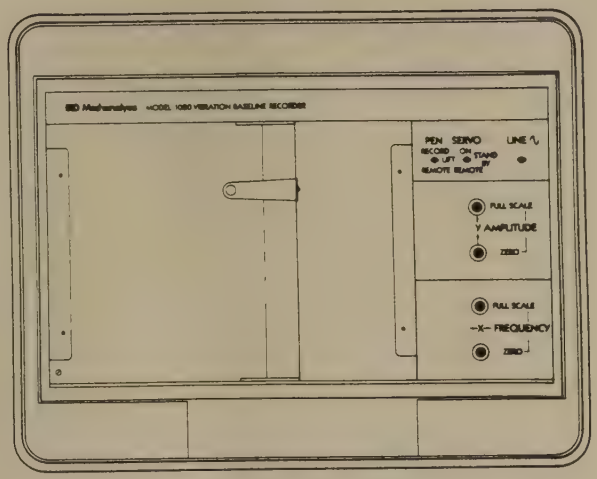
MODEL 1080 VIBRATION BASELINE RECORDER SPECIFICATIONS

DESCRIPTION

The Model 1080 Portable Chart Recorder P/N 18323 makes graphical plots of vibration amplitude or phase as a function of frequency Direct-current (DC) signals proportional to amplitude and frequency, or phase and frequency are obtained from compatible analyzers

The recorder is a rugged unit, easy to operate and well suited for field use Pen-drive servo amplifiers are all solid-state Disposable felt-tipped pen cartridges are clean to handle and have excellent writing characteristics.

A foam lined fiberglass carrying case protects the recorder and has space for cables and accessories



SPECIFICATIONS

Chart size	8 5 x 11 inches (21 6 x 27 9 CM)
Chart Holddown	Electrostatic
Pen	Felt-tipped Cartridge
Pen Lift	Electric, local and remote control
Input Ranges (X)	100 mV to 2 V per inch continuously variable vernier
(Y)	280 mV to 2.8 V per inch continuously variable vernier
Input Resistance (X and Y)	1 megohm
Zero Set (X and Y)	Zero is adjustable up to one full scale in any direction.
Slewing Speed	20 inches/second
Dimensions (Case)	19 75 in x 14 5 in. x 7 in (50 2 cm x 36.8 cm x 17 8 cm)
Temperature Range	+32°F to +131°F (0°C to +55°C)
Relative Humidity Range	0 to 80% (40°C)
Weight	29 lbs (13 2 kg)
Power	105-129V/210-258V 50/60/400 Hz 70 VA max.

Standard Accessories

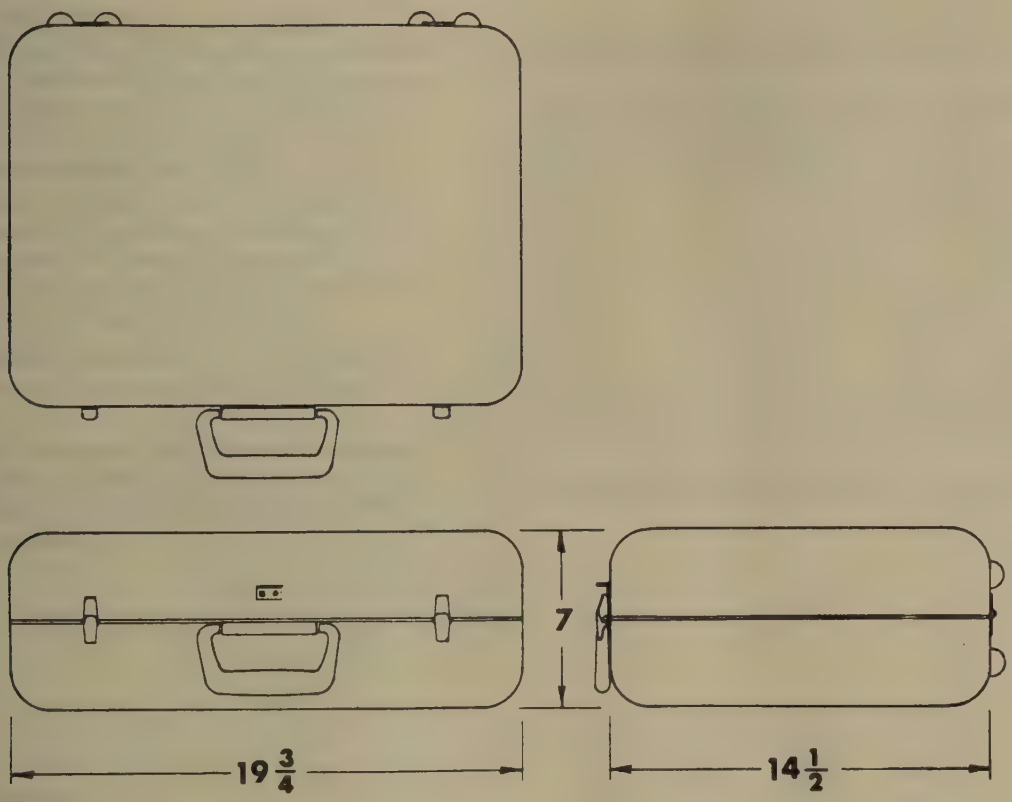
(1) Signal cable 5 ft P/N 11866 (BNC connectors on analyzer end)
(20) Pen Cartridges
Pkg/5 Red P/N 11514
Pkg/5 Blue P/N 11515
Pkg/5 Green P/N 11516
Pkg/5 Black P/N 11517
(2) Spare Fuses
(1) ½ Amp P/N 12792
(1) ¼ Amp P/N 12793
(1) Slidewire Maintenance Kit Cleaner P/N 11921
(1) Power Cable P/N 11919
(1) Recorder Operation Manual P/N 18507 (S/N Prefix B)
(1) Pad (25 Sheets) Model 350 Data Sheets P/N 10601
(1) Pad (25 Sheets) Model 360 Data Sheets P/N 11727
(1) Pad (25 Sheets) Model 850 Data Sheets P/N 12169

Optional

Spare Parts Kit P/N 18508 (S/N Prefix B)

MODEL 1080 VIBRATION BASELINE RECORDER SPECIFICATIONS CONTINUED

OUTLINE DRAWING



ORDERING INFORMATION

(Qty) Model 1080 Portable Vibration Recorder Complete with Standard Accessories P/N 18323

MODEL 1081 VIBRATION BASELINE RECORDER SPECIFICATIONS

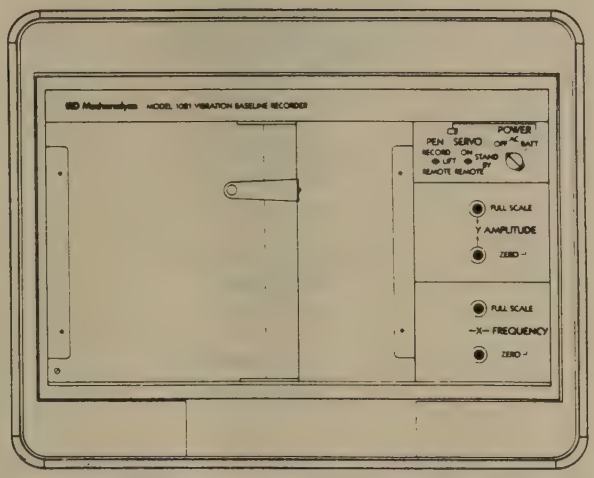
DESCRIPTION

The Model 1081 Portable Chart Recorder makes graphical plots of vibration amplitude or phase as a function of frequency. Direct-current (DC) signals proportional to amplitude and frequency, or phase and frequency are obtained from compatible analyzers.

The recorder is a rugged unit, easy to operate and well suited for field use. Pen-drive servo amplifiers are all solid-state. Disposable felt-tipped pen cartridges are clean to handle and have excellent writing characteristics.

A foam lined fiberglass carrying case protects the recorder and has space for cables and accessories.

The recorder operates from internal rechargeable batteries, or power line. Its response characteristics are optimized for use with IRD vibration analyzers.



SPECIFICATIONS

Chart Size	8.5 x 11 inches (21.6 x 27.9 CM)
Chart Holddown	Mechanical
Pen	Felt-tipped Cartridge
Pen Lift	Electric, local and remote control
Input Ranges (X)	100mV to 2V per inch continuously variable vernier
(Y)	280mV to 2.8V per inch continuously variable vernier
Input Resistance (X and Y)	1 megohm
Zero Set (X and Y)	Zero is adjustable up to one full scale in any direction
Temperature Range	+32°F to +131°F (0°C to +55°C)
Relative Humidity Range	0 to 95% (40°C)
Slewing Speed	18.5 inches/second
Dimensions (Case)	19.75 in. x 14.5 in. x 7 in. (50.2 cm x 36.8 cm x 17.8 cm)
Weight	33 lbs. (15.0 kg)
Power	Switch selectable 100. 115, 200 or 230 Vac (± 10%) 50/60/400 Hz. 70 VA max. Internal rechargeable batteries (and battery charger): 2.5 hours continuous battery operation (8 hours intermittent)

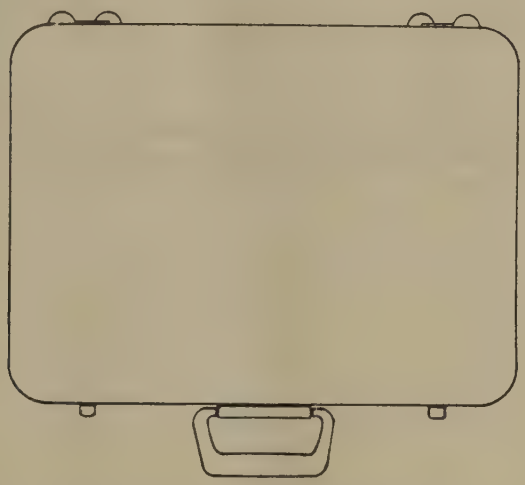
MODEL 1081 VIBRATION BASELINE RECORDER SPECIFICATIONS CONTINUED

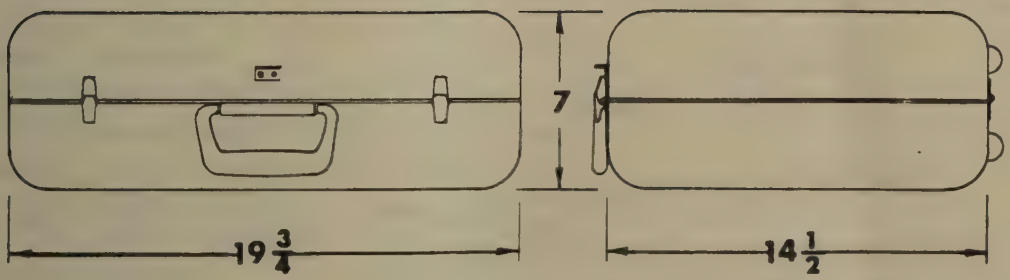
Standard Accessories

- (1) Signal Cable 5 ft.
  P/N 11866
  (BNC connectors on analyzer end)
- (20) Pen Cartridges
  Pkg/5 Red
  P/N 11514
  Pkg/5 Blue
  P/N 11515
  Pkg/5 Green
  P/N 11516
  Pkg/5 Black
  P/N 11517
- (2) Spare Fuses
- (1) 1/2 Amp
  P/N 12792
- (1) 1/4 Amp
  P/N 12793
- (1) Slidewire Maintenance Kit
  Cleaner
  P/N 11921
- (1) Power Cable
  P/N 11919
- (1) Recorder Operation Manual
  P/N 15841
- (1) Pad (25 Sheets)
  Model 350 Data Sheets
  P/N 10601
- (1) Pad (25 Sheets)
  Model 360 Data Sheets
  P/N 11727
- (1) Pad (25 Sheets)
  Model 850 Data Sheets
  P/N 12169
- (6) Batteries
  P/N 15840

Optional

Spare Parts Kit P/N 17980





ORDERING INFORMATION

(Qty) Model 1081 Portable Vibration Baseline Recorder Complete with Standard Accessories P/N 15842

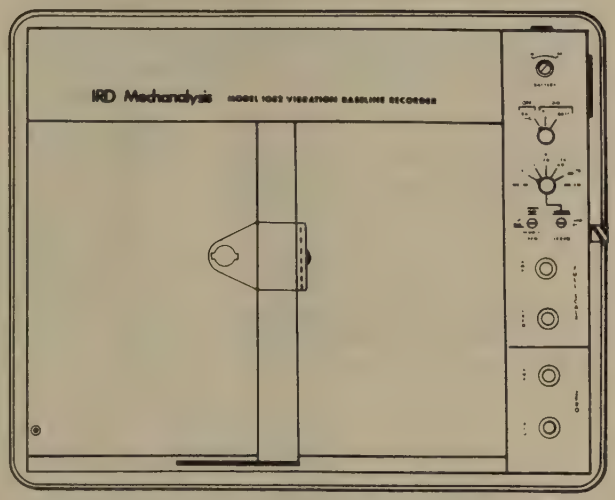
MODEL 1082 VIBRATION BASELINE RECORDER SPECIFICATIONSD

DESCRIPTION

The Model 1082 Vibration Baseline/Time Plotter is a portable unit for making graphical plots of vibration amplitude (or phase) vs. frequency using direct current (d.c.) signals proportional to amplitude, phase and frequency from compatible vibration analyzers. It is a rugged unit which is well suited for industrial service with all solid-state pen servo drivers, and has been designed for ease of operation under field conditions. Its response characteristics are optimized for use with IRD analyzers.

The plotter also has a built-in time base which converts its function from plotting amplitude (or phase) vs. frequency to amplitude (or phase) vs. time. This is an important feature where time varying signals are encountered. A selector switch permits sweep speeds of 1, 5, 20, 60 and 180 seconds/inch, or approximately 0.4, 2, 8, 24 and 70 seconds/centimeter. These sweep speeds result in plotting times of 10 sec., 50 sec., 3 min., 10 min. and 30 min. respectively, on 10 inch (25 centimeter) plotting paper.

The plotter comes equipped for a.c. power operation as standard. Battery operation can be added, however, by inserting an (optional) internal, replaceable, rechargeable battery pack. The battery pack can be easily installed by the operator; and can be recharged without removal from the Model 1082 by an internal battery charger circuit which also protects the battery from overcharge. Extra battery packs (readily field changeable) are available when extended operation on battery power is required.



SPECIFICATIONS

Chart size	8.5 x 11 inches (21.6 x 27.9 CM)
Chart Holddown	Mechanical
Pen	Felt-Tipped Cartridge
Pen Lift	Electric, local and remote control
Input Ranges (X)	100mV to 2 V per inch continuously variable vernier
(Y)	280 mV to 2.8 V per inch continuously variable vernier
Input Resistance (X and Y)	1 megohm
Zero Set (X and Y)	Zero is adjustable up to one full scale in any direction
Slewing Speed (X)	5 in/sec.
(Y)	10 in/sec.
Dimensions (Case)	17 in x 14-1/2 in x 6-1/2 in (43.2 cm x 36.8 cm x 16.5 cm)
Temperature	+32°F to +131°F (0°C to +55°C)
Relative Humidity Range	0 to 95% (40°C)
Time Base (Sweep Speed)	1, 5, 20, 60 or 180 sec/in., (.4, 2, 8, 24, or 70 sec/cm.)
Weight - without batteries	23 lbs. (10.4 kg)
with batteries	28 lbs. (12.7 kg)
Power - A.C.	Selectable 100, 115, 200, 230 Vac (± 10%); 50/60/400 Hz., 70 VA max.
(Optional) Battery	Internal Rechargeable; Operating Time: 4 hours continuous plotting; Recharge Time: 9 hours

MODEL 1082 VIBRATION BASELINE RECORDER SPECIFICATIONS CONTINUED

STANDARD ACCESORIES

(1) Signal cable to connect plotter to analyzer.
Specify:*
- For Model 350, 360, 850/860: 6 ft. signal cable, P/N 21359, or
- For Model 840: 4 ft. signal cable, P/N 21063

(20) Pen Cartridges:
Pkg/5 Red P/N 11514
Pkg/5 Blue P/N 11515
Pkg/5 Green P/N 11516
Pkg/5 Black P/N 11517

(2) Spare Fuses:
(1) 1/2 amp P/N 12792,
(1) 1/4 amp P/N 12793

(1) Slidewire Maintenance Kit Cleaner P/N 11921

(1) 1 Meter Power Cable to connect Model 1082 to Model 840 (Int'l [Female] - Int'l [Male]) P/N 19644

(1) 3 Meter Power Cable to connect Model 1082 to U.S. Std. (Female) power receptacle. (Int'l [Female] - U.S. Std. [Male]) P/N 19643

(1) Reorder Operation Instruction Manual P/N 23201 and Addendum P/N 22719

(1) Pad (25 Sheets) Standard Single Plot Data Sheets for plotting amplitude vs Frequency.

Specify:
- Form 1330 for Model 350: P/N 10601 - or,
- Form 1367 for Model 360: P/N 11727 - or,
- Form 1610 for Model 850/860: P/N 12169 - or,
- Form 1851 for Model 840: P/N 21388

(1) Pad (25 Sheets) Form 1865 Data Sheets for plotting Amplitude (or Phase) vs. RPM, or Amplitude (or Phase) vs. Time P/N 21389

NOTE: Be sure to specify the instrument model with which the Model 1082 is to be used.

OPTIONAL ACCESSORIES

Spare Parts Kit P/N 21390
Battery pack, P/N 21311

Extra 6 ft. signal cable to connect Model 1082 plotter to Model 350, or 360, or 850/860, P/N 21359.

Extra 4 ft. Signal Cable to connect Model 1082 Plotter to Model 840 P/N 21063.

Extra pads (25 sheets) of Data Sheets for plotting Amplitude vs. Frequency. Shipped in lots of 30 pads only.
Specify:*

- For Model 350:
  Form 1330, Standard Single Plot Data Sheet, P/N 10601
  Form 1425A, Triaxial Plot Data Sheet, P/N 12639.
  Form 1655, Noise Plot Data Sheet P/N 21391
- For Model 360:
  Form 1367, Standard Single Plot Data Sheet, P/N 11727
  Form 1368, Triaxial Plot Data Sheet, P/N 11728
  Form 1369, Multi-plot Data Sheet, P/N 11729
  Form 445, Polar Coordinate Data Sheet, P/N 11725 (for Nyquist Plots)
- For Model 850/860:
  Form 1610, Standard Single Plot Data Sheet, P/N 12169
  Form 1611, Multi-plot Data Sheet P/N 12975
  Form 1612, Triaxial Plot Data Sheet, P/N 12976
- For Model 840:
  Form 1851, Standard Single Plot Data Sheet, P/N 21388
  Form 1852, Triaxial Plot Data Sheet, P/N 21392

  Extra Pad (25 Sheets) Form 1865 Data Sheets for plotting Amplitude (or Phase) vs. RPM, or Amplitude (or Phase) vs. Time P/N 21389. Shipped in lots of 30 pads only.

ORDERING INFORMATION

The following **MUST** be specified when ordering:

1) Type instrument(s) with which Model 1082 will be used:
☐ 840, ☐ 350, ☐ 850/860, ☐ other (_____).

2) **Battery Option:** ☐ with battery, ☐ without battery

3) **Voltage:** ☐ 90-105, ☐ 104-126, ☐ 190-230, ☐ 208-252

4) **Power Cable:** ☐ U.S. Standard, ☐ European: same as U.S. Std., but no connector on mains end and (CEE) European Color Coding. Mains connector to be supplied by customer.

APPENDIX B

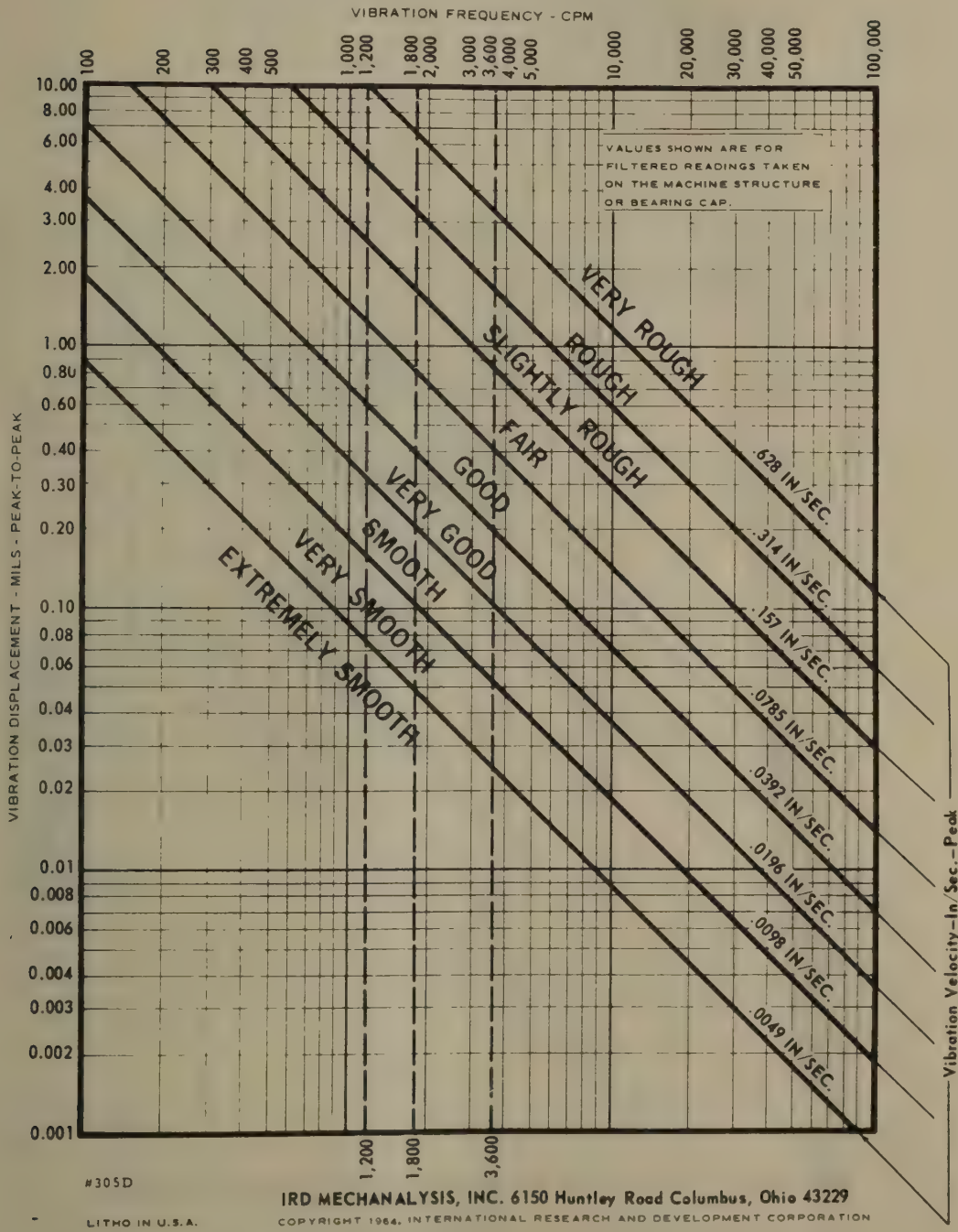
Guideline
Vibration Severity Charts

- General Machinery Vibration Severity Chart in English
- General Machinery Vibration Severity Chart in Metric.
- General Machinery Vibration Severity Chart in Acceleration.

MEMORANDA

GENERAL MACHINERY
VIBRATION SEVERITY CHART

For use as a GUIDE in judging vibration as a warning of impending trouble.



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LITHO IN U.S.A.

IRD MECHANALYSIS, INC. 6150 Huntley Road Columbus, Ohio 43229

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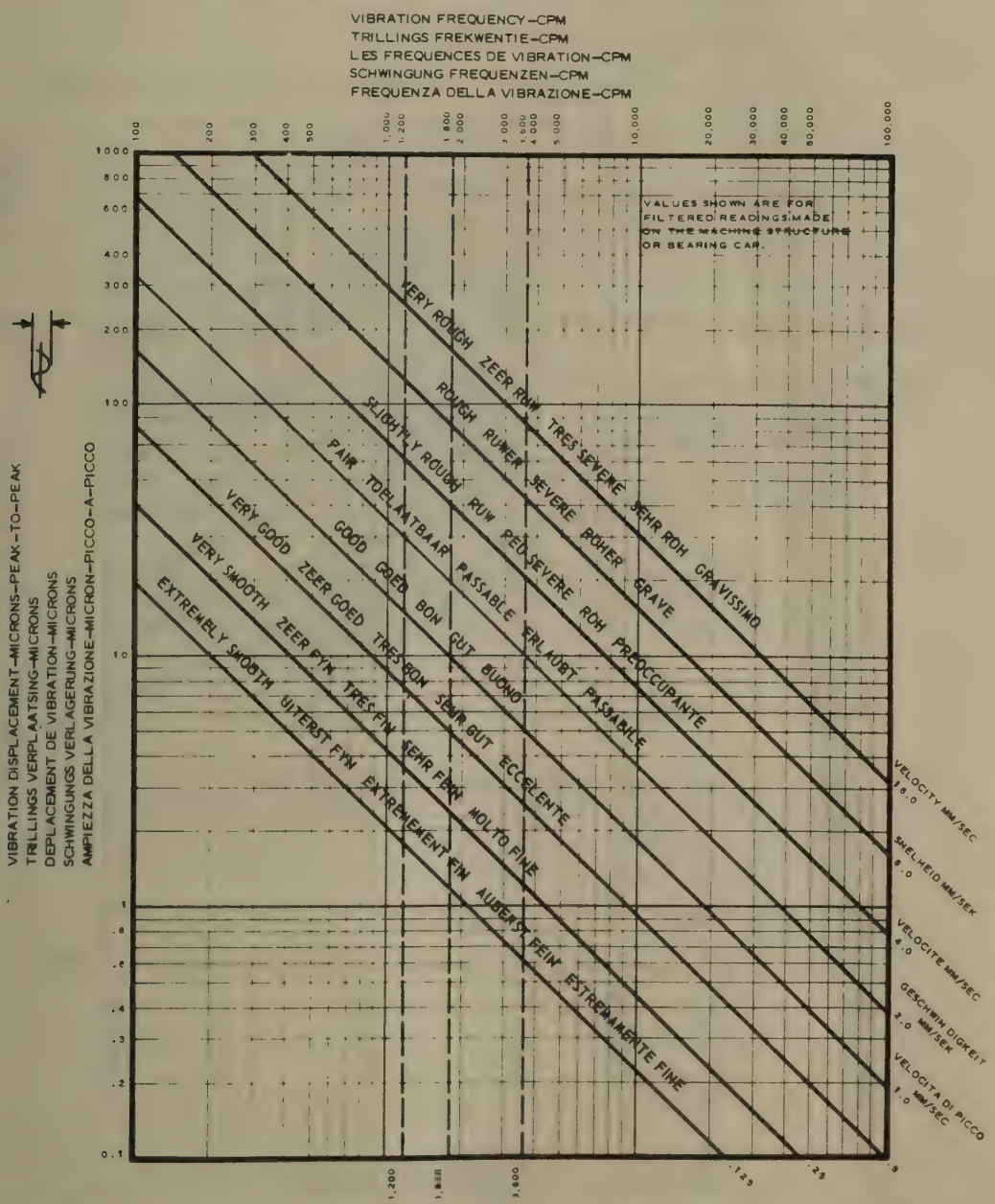
IRD-MECHANALYSIS INTERNATIONAL

GENERAL MACHINERY VIBRATION SEVERITY CHART
TRILLINGS STRENGHEIDSKAART VOOR ALGEMENE MACHINES
TABLEAU DE SEVERITE VIBRATOIRE POUR LES MACHINES EN GENERAL
SCHWINGUNGSSTRENGE TABELLE FUR ALLGEMEINE MASCHINEN
NOMOGRAMMA GENERALE DI PERICOLOSITA DELLA VIBRAZIONE



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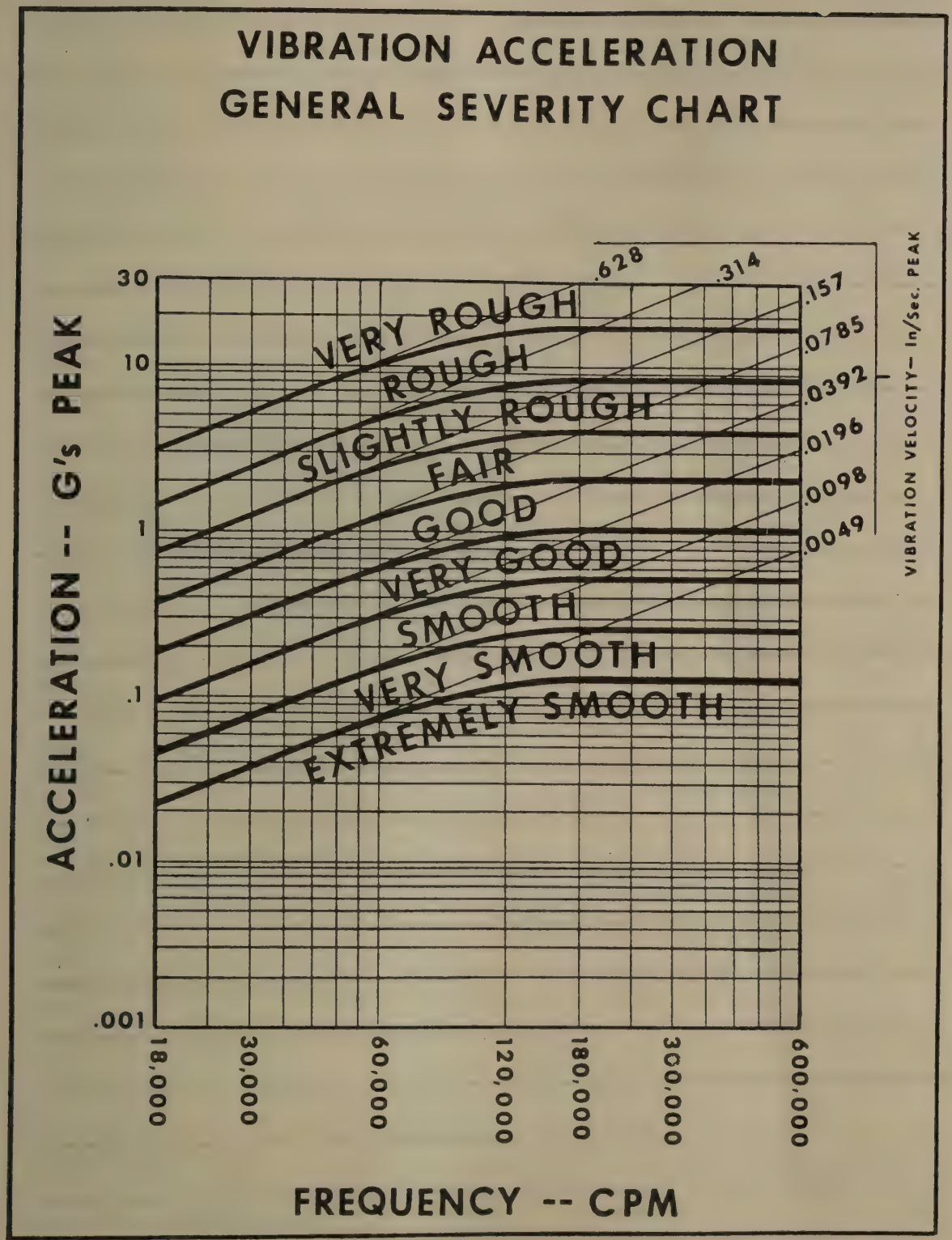

VIBRATION ACCELERATION
GENERAL SEVERITY CHART
ACCELERATION -- G's PEAK
30
10
1
.1
.01
.001
VERY ROUGH
ROUGH
SLIGHTLY ROUGH
FAIR
GOOD
VERY GOOD
SMOOTH
VERY SMOOTH
EXTREMELY SMOOTH
.628
.314
.157
.0785
.0392
.0196
.0098
.0049
VIBRATION VELOCITY- In/Sec. PEAK
18,000
30,000
60,000
120,000
180,000
300,000
600,000
FREQUENCY -- CPM

MEMORANDA

APPENDIX C

USE OF SPIKE ENERGY TO DETECT DEFECTS IN ROLLING ELEMENT BEARINGS AND GEARS

Spike Energy Circuits C-1
Establishing a Bearing Defect Detection Program C-1
Gear Defects. C-2
Other Sources of Spike Energy C-2
Rolling Element Bearing g-SE Severity C-2
Rolling Element Bearing g-SE Severity Chart C-3

MEMORANDA

USE OF SPIKE ENERGY TO DETECT DEFECTS IN ROLLING ELEMENT BEARINGS AND GEARS

SPIKE ENERGY CIRCUITS

The spike energy detection circuits are designed to sense the amplitude of the microsecond range pulses caused by impacts between bearing elements which have microscopic flaws. In addition to detecting pulse amplitude, these circuits also detect the rate of occurrence of the pulses and the amplitude of the high frequency random broad band vibratory energy associated with bearing defects. These three parameters of pulse amlitude, pulse rate and high frequency random vibratory energy are electronically combined into a single quantity called "g-SE" which is a measure of bearing condition. The term "g-SE" (i.e., acceleration units of spike energy) has been selected to indicate that this type measurement is more comprehensive than g-peak and g-RMS measurements.

ESTABLISHING A BEARING DEFECT DETECTION PROGRAM

To establish a program for checking the condition of rolling element bearings, a "comparison" method can be used. That is, the g-SE levels of similar machines are measured and any levels which significantly depart from the average are singled out for further analysis, and closer watch, as potential bearing problems. This method rapidly leads to establishment of criteria levels which distinguish good and bad bearings. It should be noted in this connection that the g-SE levels depend on machine rotational speed (RPM), and typically double for each doubling of RPM. From a vibration severity standpoint, however, it should be kept in mind that low speed bearings can usually tolerate more damage than high speed bearings, since low speed bearings tend to deteriorate more slowly than high speed.

The use of "trending" is another way of detecting defective bearings. In this method, the machine bearings are measured periodically and their g-SE levels recorded. No change in level over a period of time indicates a good bearing, while a significant upward trend indicates a deteriorating bearing.

As an additional aid in establishing g-SE level criteria for good and bad bearings, general experience indicates that when making bearing checks of machines in the 600 to 3600 RPM range with the 9-inch probe, a g-SE level of 0.5 or greater is often an indicator of a defective bearing. This number should, of course, be used with caution since many factors can affect the level measured, such as bearing type, machine type, etc. It should also be noted that where greater sensitivity to bearing defects is desired, the transducer can be flush mounted (i.e.,

without 9-inch probe) to the bearing housing. In all cases the probe, or transducer, should contact the bearing housing with a light, steady pressure in such a manner that no chatter occurs.

GEAR DEFECTS

A program to detect incipient gear defects can be established in the same manner as that described above for rolling element bearings.

OTHER SOURCES OF SPIKE ENERGY

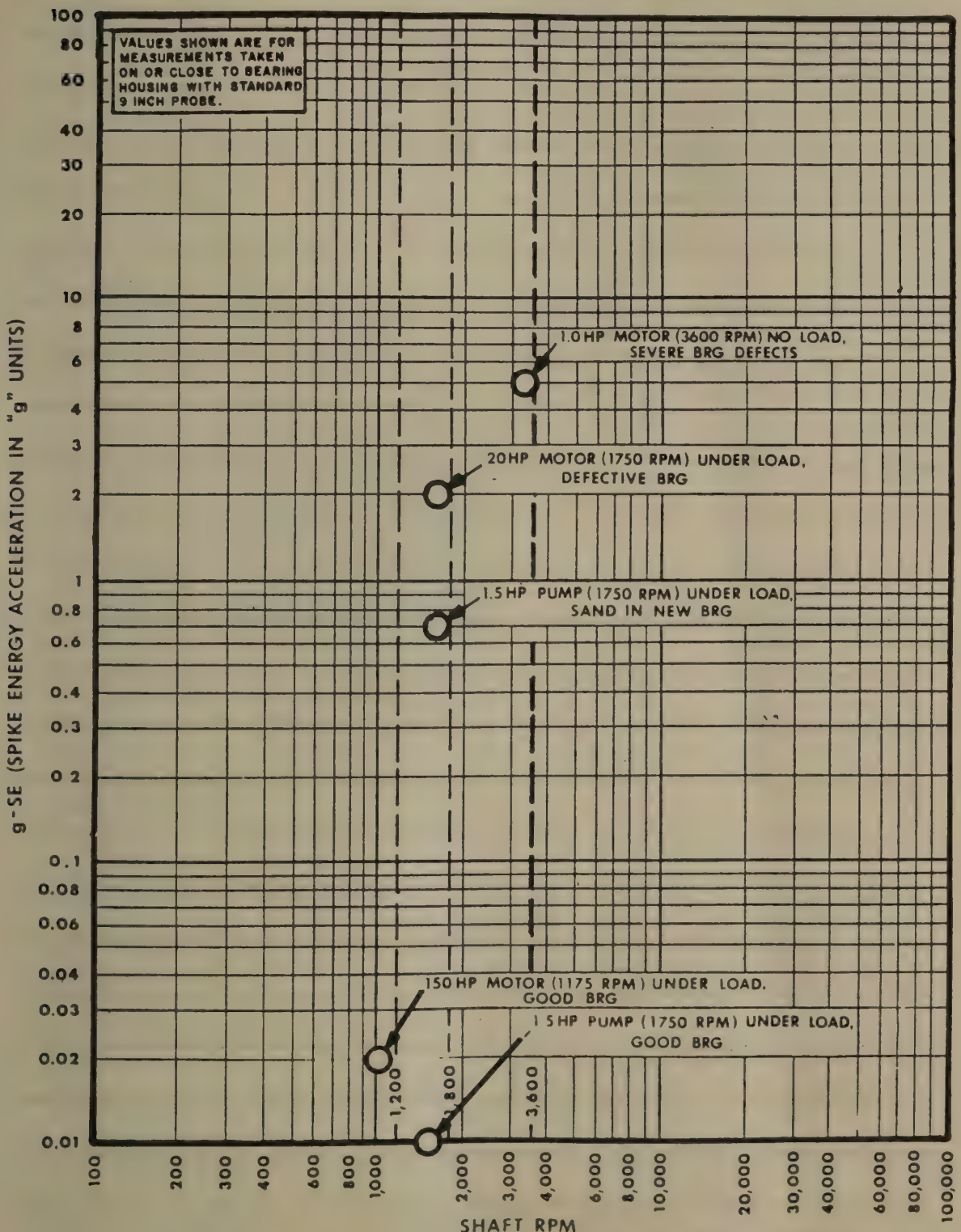
When taking bearing checks, it must be kept in mind that there are sources other than bearings which give off spike energy. Gears, cavitation, rubbing or striking of metal parts such as seals and coupling guards, are some of the more common sources which are likely to be encountered. These sources, if close to the bearing measured, should be checked to avoid possible misinterpretation of the data.

ROLLING ELEMENT BEARING g-SE SEVERITY CHART

A "Rolling Element Bearing g-SE Severity Chart" is shown in the accompanying chart. This chart can be used as an aid in establishing g-SE severity criteria. No specific severity levels such as "smooth", "good", etc., have been assigned, since there are too many variables (bearing types, machine types, speed, loads, etc.) which can affect the levels measured. Some case histories, however, are polotted on the chart to provide an indication of the type results which can be obtained.

By plotting the g-SE levels of the machines to be included within a bearing check program on a chart, severity criteria can be readily developed which are tailored to the individual machines involved. These charts are available from IRD Mechanalysis.

ROLLING ELEMENT BEARING g-SE SEVERITY CHART



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